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AIR SPARGING/ SOIL VAPOR EXTRACTION REPORT FOR OPERABLE UNIT 3 (OU 3) SITE
26 NWS EARLE NJ
2/10/2000
FOSTER WHEELER ENVIRONMENTAL CORPORATION

Earle

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NORTHNAVFACENGCOM 4335/3 (Rev. 6/80)

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CONTRACT NO. N62472-94-D-0398	DELIVERY ORDER 0055	ACTIVITY LOCATION Naval Weapons Station Earle, Colts Neck, NJ
PROJECT TITLE: AIR SPARGING/SOIL VAPOR EXTRACTION OPERABLE UNIT #3 - SITE 26		
FROM: Foster Wheeler Environmental Corp. - Program QCM: Mark Miller		DATE February 10, 2000
TO: W FAUSTMAN (3 COPIES)		DATE February 10, 2000

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ITEM NO.	SUBMITTAL DESCRIPTION	PREPARED/ SUBMITTED BY	APPROVED	DISAPPROVED	REMARKS
2	SD-18, Records; Final Remedial Action Plan (AS/SVE)	M. Miller			

FINAL REMEDIAL ACTION PLAN FOR AIR SPARGING/SOIL VAPOR EXTRACTION

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NWS-EARLE: SITE 26
AIR SPARGE/SVE DESIGN AND WORK PLAN

1.0 INTRODUCTION

Foster Wheeler Environmental Corporation (Foster Wheeler Environmental) has been contracted by the Northern Division, Naval Facilities Engineering Command (NORDIV) to design and construct an air sparging/soil vapor extraction (AS/SVE) system for Operable Unit No.3 (OU-3) Site 26, at the Naval Weapons Station (NWS) Earle located in Colts Neck, NJ. This Work Plan is being submitted to satisfy the pre-construction submittal requirements included in paragraph 1.2.1, Pre- and Post-Construction Documentation of the Statement of Services for Delivery Order No. 0034 under Remedial Action Contract No. N62472-94-D-0398. The Health and Safety Plan for this effort will be submitted as a separate document.

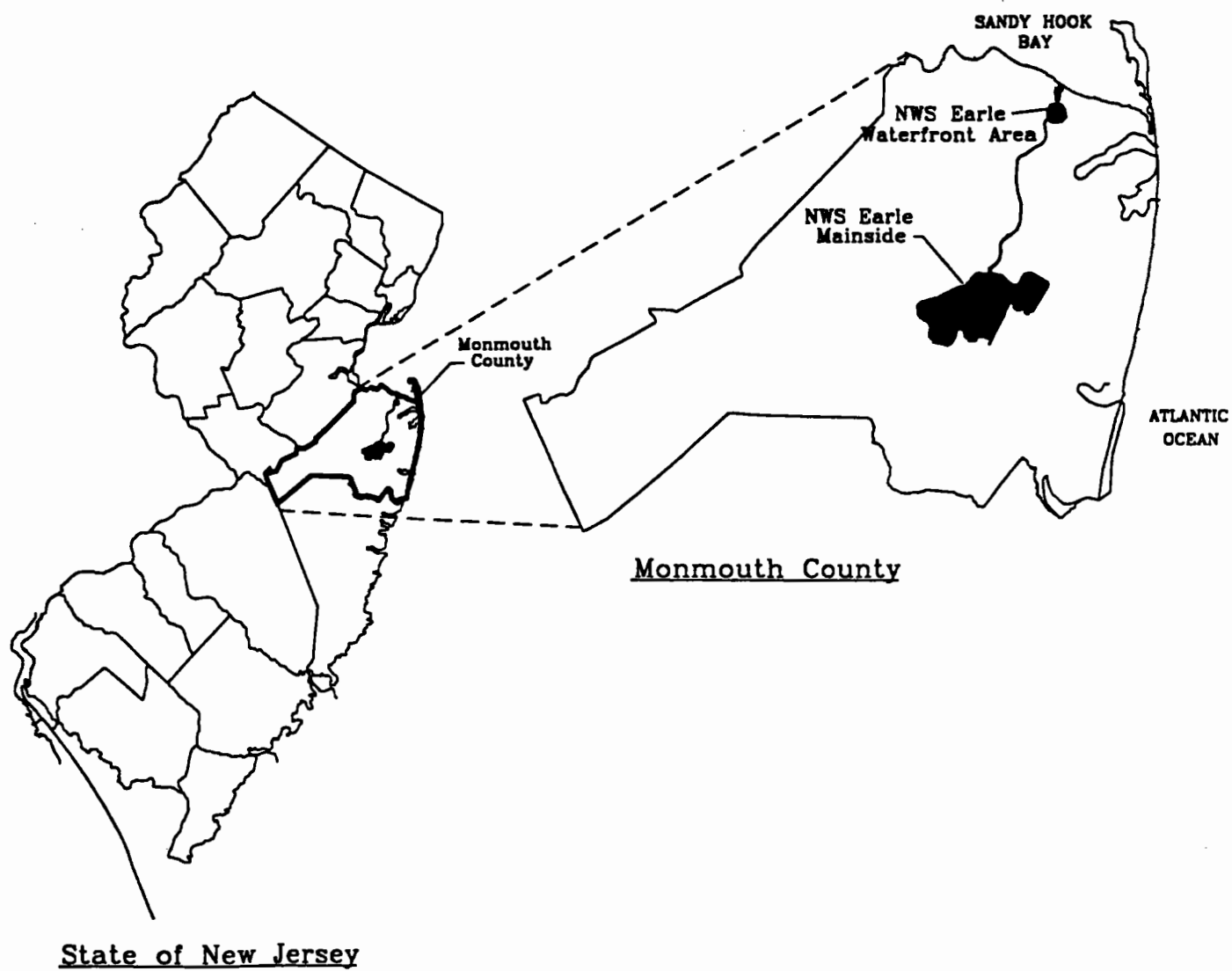
In accordance with the approved Proposed Plan for OU-3 (B&R, 1997a), the objective for the AS/SVE system is to remediate groundwater in the shallow aquifer that has been impacted by chlorinated hydrocarbons. Remediation will be accomplished by sparged (injected) air volatilizing VOCs in the saturated zone, and capture of volatilized VOCs using soil vapor extraction. In addition, although chlorinated compounds are not readily biodegraded, natural biodegradation will be enhanced by increasing the dissolved oxygen content within the shallow aquifer. The system is designed to fully-remediate the existing contaminant plume to below groundwater quality standards established by the New Jersey Department of Environmental Protection (NJDEP). The period of operation for this system is estimated to be approximately 18-24 months.

2.0 SITE LOCATION

NWS-Earle is located in the east-central area of Monmouth County in the town of Colts Neck, New Jersey (Figure 1). Site 26 (OU-3) is located immediately southwest of Building GB-1, which is located within the Ordnance Area on the Mainside portion of the NWS-Earle facility, at the intersection of Macassar and Midway Roads. Two railway lines run from the southwest to the northeast adjacent to the southern side of Building GB-1 (Figure 2). The site is fenced and topography is relatively flat, approximately 150 feet above MSL.

3.0 SITE HISTORY

Building GB-1 was reportedly used for the reconditioning of munition casings and shells. Solvents were used in the reconditioning process. Spent solvents and wash waters were discarded into an unknown receptacle, possibly a collection tray at a former paint spray booth, which drained to the process leaching system. The GB-1 process leaching system was apparently used for disposal of trichloroethene (TCE), 1,2-dichloroethene (DCE), and/or related compounds. GB-1 is no longer used for processing activities. The facility is used for warehousing and storage.



NOT TO SCALE

U.S. Navy RAC
NWS-Earle, Colts Neck, N.J.

Figure 1
Regional Site Map

maprac\work\site26\fig2

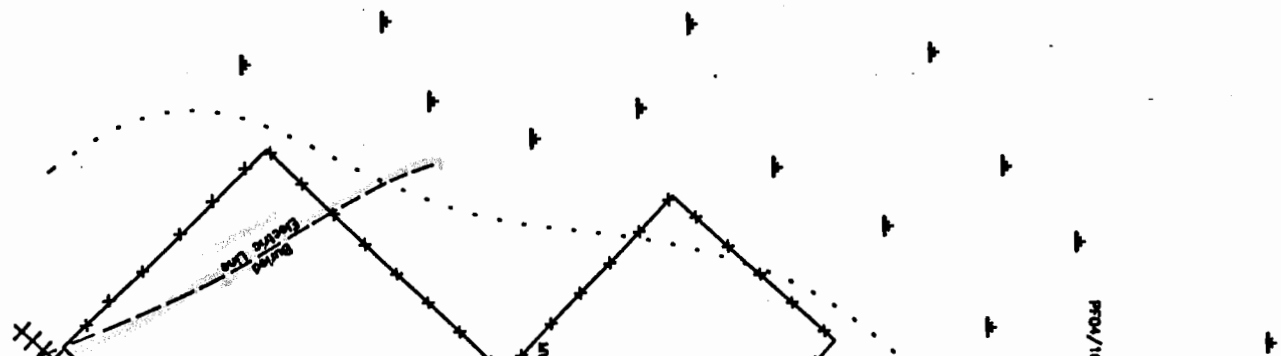


FIG 2/11

Several studies have been conducted at the site, dating back to the Initial Assessment Study in 1982. Site inspections and a Remedial Investigation/Feasibility Study (RI/FS) were conducted in the early 1990's after NWS-Earle was placed on the National Priorities List (NPL). A Phase II RI was completed in 1996, and included: a soil gas survey at 68 locations; installation and sampling of groundwater monitoring wells; soil sampling; "direct push" groundwater sampling with on-site laboratory analysis; and cone penetrometer studies to delineate subsurface soil stratigraphy.

Groundwater samples collected from the direct-push samplers revealed an elongated plume of chlorinated compounds in shallow groundwater immediately southwest of Building GB-1. The contaminant plume is approximately 420 feet long by 150 feet wide, and appears to be confined to an upper sand aquifer which extends to a depth of approximately 25 feet below ground surface (bgs). The upper sand aquifer is underlain by approximately 15 feet of low permeability silts and clays.

The leaching system and associated sludge immediately northwest of Building GB-1 were removed/remediated in 1998, as described in the Site 26 Close-Out Report prepared by Foster Wheeler in July 1998 (FWENC, 1998).

Based on the Feasibility Study conducted in 1997, the remedial alternative selected for groundwater remediation at Site 26 is AS/SVE.

4.0 SITE HYDROGEOLOGY

NWS-Earle is situated in the Coastal Plain Physiographic Province of New Jersey. The Coastal Plain consists of a series of seaward-dipping unconsolidated sediments of Cretaceous through Quaternary Age, deposited atop pre-Cretaceous bedrock. The Coastal Plain sediments were deposited in continental, coastal, and marine depositional environments, and consist of numerous sequences of sand and gravel, silt, and clay. These deposits generally strike northeast-southwest, and dip to the southeast at 10 to 60 feet per mile. The Coastal Plain section is nearly 900 feet thick beneath NWS-Earle.

Site 26 occurs in the outcrop area of the Kirkwood Formation, which ranges in thickness between 60 to 100 feet in the area. Soil borings at Site 26 have encountered light yellowish-brown sands and gravel (considered representative of upland gravel) and brownish-yellow, brown and gray, fine- to medium- and medium- to coarse-grained sands (indicative of the Kirkwood Formation). The sandy units are separated by intercalated silts, silty clay, and clay layers. Appendix A contains lithologic logs for the first three wells installed as part of the AS/SVE Pilot Test.

4.1 GROUNDWATER

Shallow groundwater at Site 26 occurs in part of the Kirkwood-Cohansey aquifer system, which is one of five major aquifer systems within the New Jersey Coastal Plain. The Kirkwood-Cohansey is a source of water throughout Monmouth County, and is reportedly used by residents

within a 1-mile radius of NWS-Earle. All facilities located in the Mainside Administration area are connected to public water supply (New Jersey American Water). There are several potable wells operating on-Base, the closest of which is approximately 4,000 feet northeast (upgradient) of Site 26.

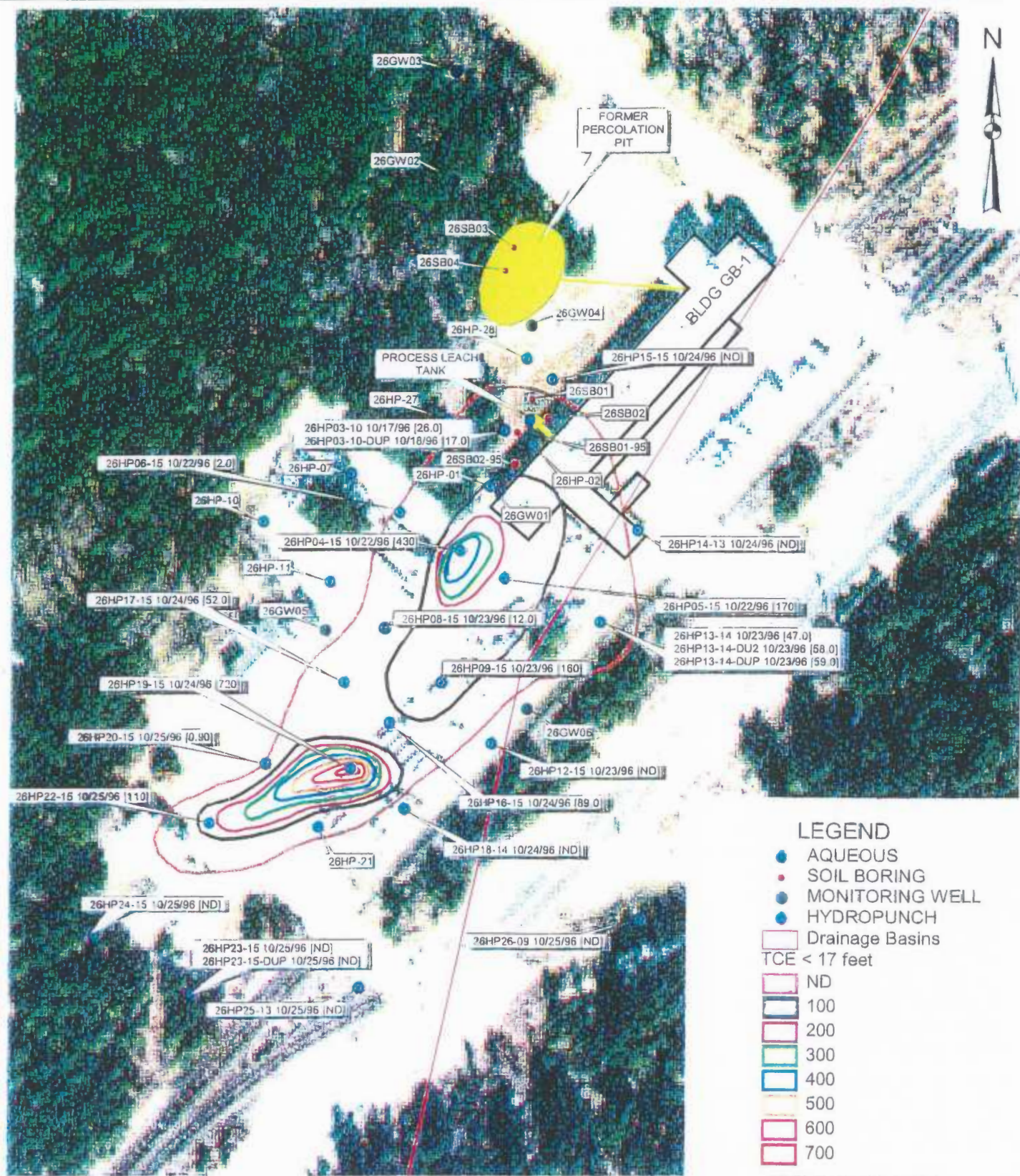
Shallow groundwater at Site 26 occurs under unconfined conditions within the upper sand unit (approximately 25 feet thick). A lower sand unit is separated from the upper sand by approximately 15 feet of low permeability silt and clay. The lower sand unit is approximately 25 feet thick, and is underlain by clayey silt. The shallow water table occurs at approximately 8-10 feet below ground surface (bgs). According to information provided in the 1996 RI Report (B&R, 1996), groundwater flow is toward the southwest at approximately 0.0045 feet/foot. There does not appear to be a significant seasonal variation in groundwater flow direction. Hydraulic conductivity for the upper sand aquifer has been estimated at between 1 to 5 feet/day (3.85×10^{-4} to 1.92×10^{-2} cm/sec).

5.0 NATURE AND EXTENT OF CONTAMINATION

Based on groundwater sampling conducted as part of the RI/FS, groundwater immediately southwest of Building GB-1 has been contaminated with chlorinated hydrocarbons (most significantly TCE and 1,2-DCE). Figures 3 through 6 illustrate the magnitude and extent of the contaminant plumes. Although these figures show concentrations in the upper and lower portions of the shallow aquifer, there is no laterally-continuous confining layer within the shallow aquifer.

The probable source for the groundwater contamination is believed to have been a former septic system located adjacent to Building GB-1. A septic leach tank, believed to be the source of groundwater contamination at Site 26, was remediated in 1998, and the results are detailed in the Site 26 - Building GB-1 Close Out Report (FWENC, 1998).

The AS/SVE system will be designed to remediate the full extent of the chlorinated hydrocarbon plume. Remediation will be accomplished via volatilization of VOCs in the saturated zone by air sparging, and capture of volatilized VOCs via soil vapor extraction. In addition, although chlorinated compounds are not readily biodegraded, biodegradation will be enhanced by increasing the dissolved oxygen content within the shallow aquifer. It should be noted that vinyl chloride is a degradation product of TCE/DCE; presence of significant quantities of vinyl chloride in the vapor extraction air stream will complicate (and increase the cost of) vapor-phase treatment alternatives.



80 0 80 160 Feet

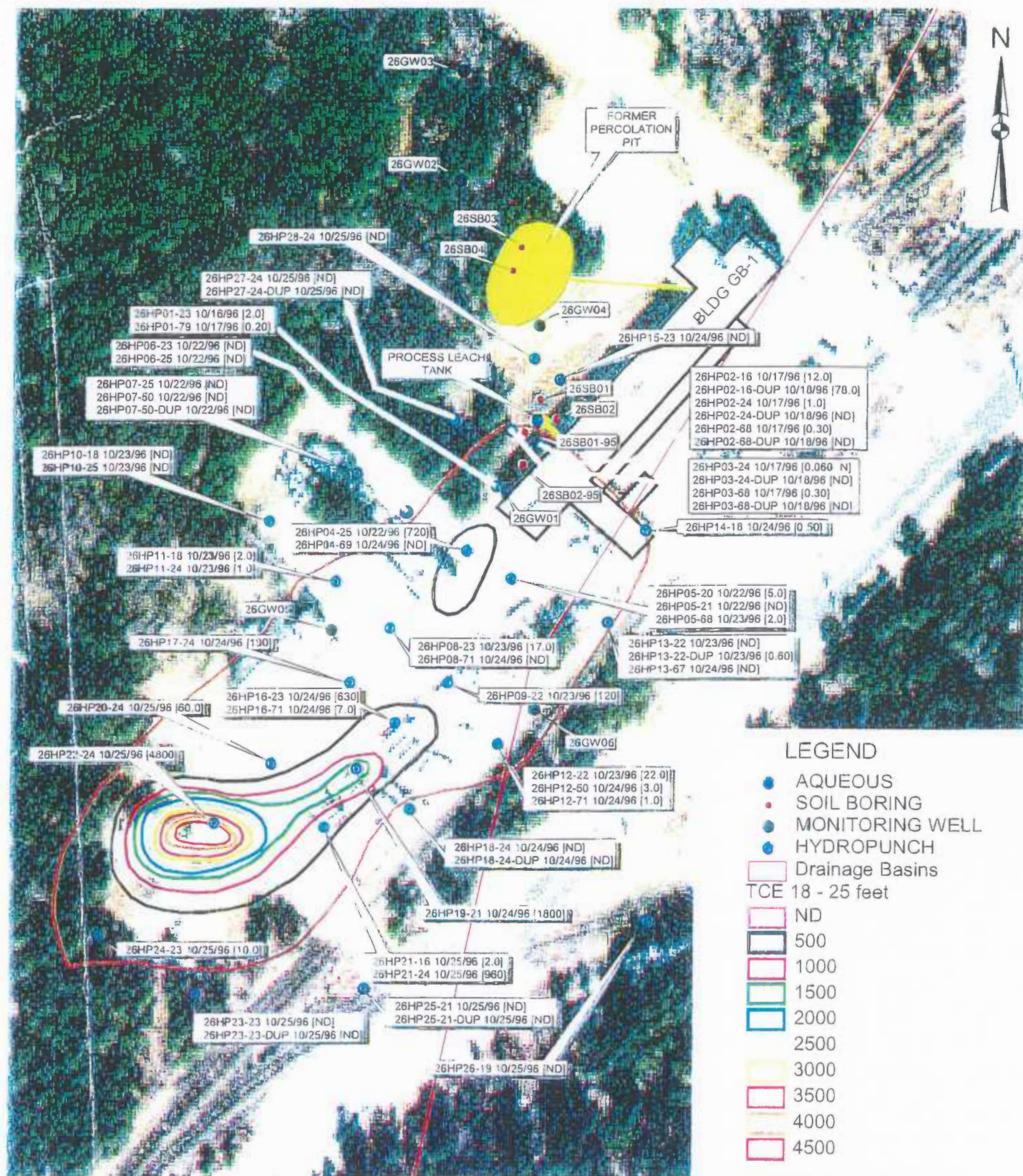
Source: Brown & Root, 1997 FS Report

U.S. Navy RAC
NWS - Earle, Colts Neck, N.J.

Figure 3
TCE Groundwater Plume
(Less than 17 feet depth)

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80 0 80 160 Feet

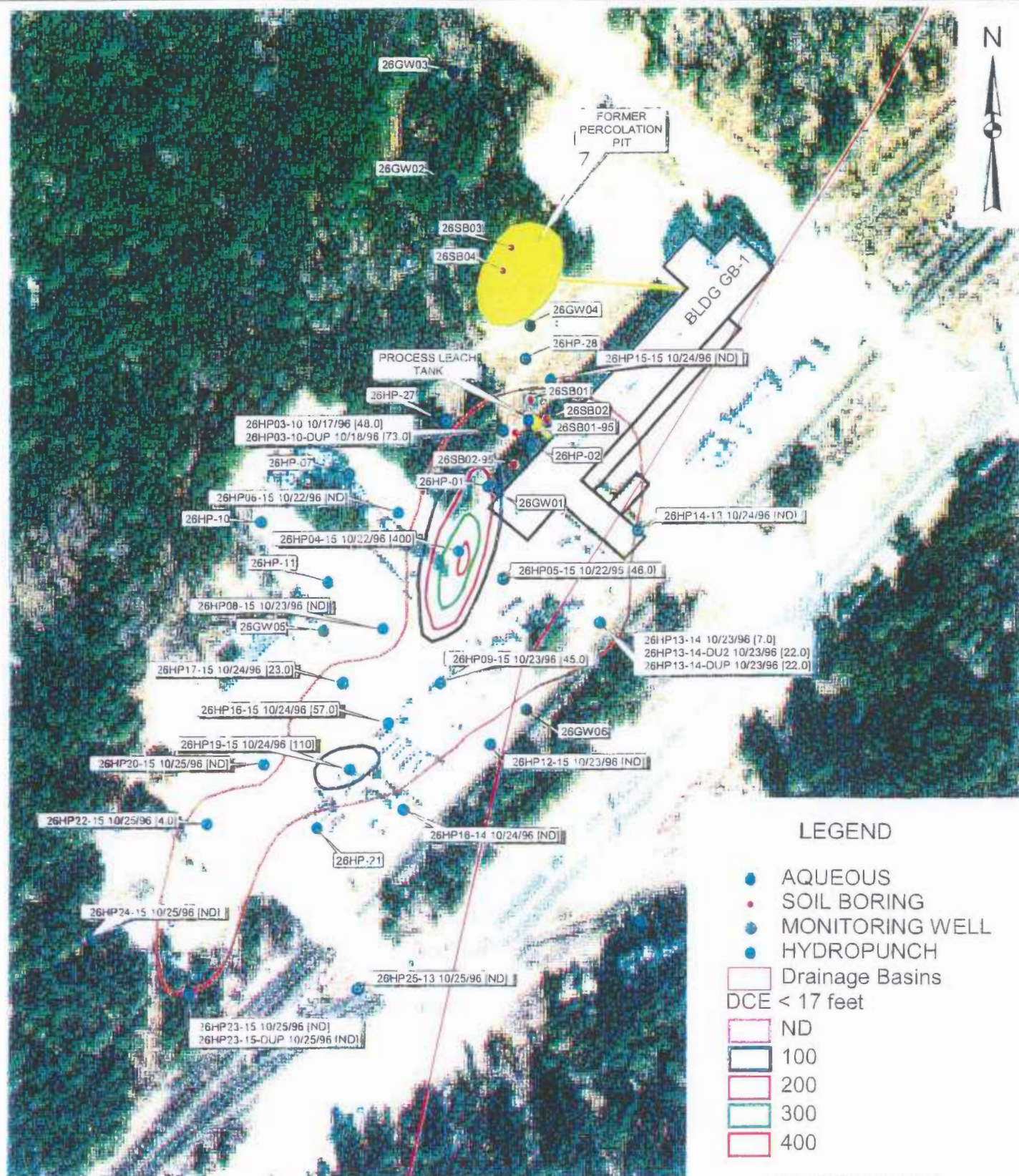
Source: Brown & Root, 1997 FS Report

U.S. Navy RAC
NWS - Earle, Colts Neck, N.J.

Figure 4
TCE Groundwater Plume
(17 to 25 feet depth)



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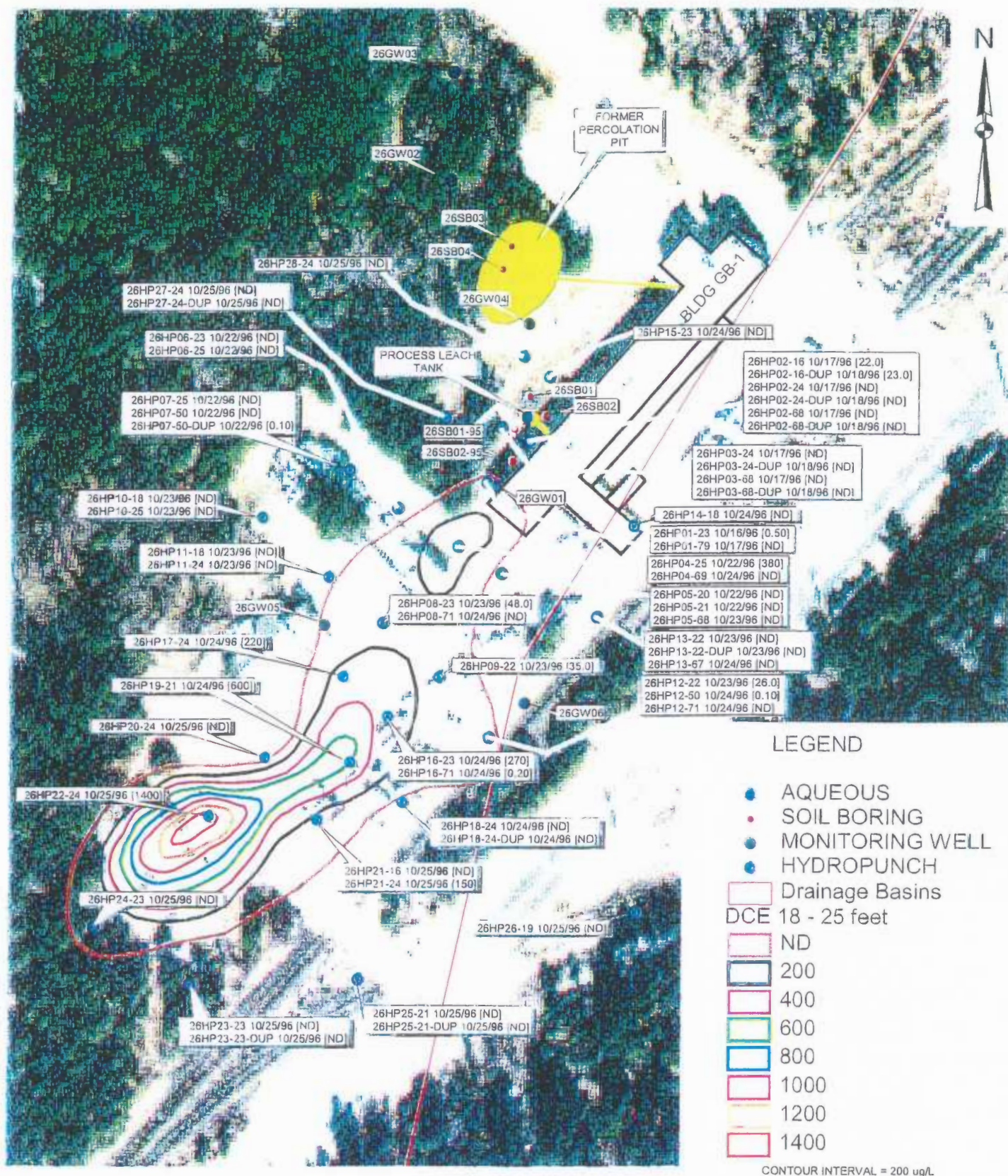
80 0 80 160 Feet

Source: Brown & Root, 1997 FS Report

U.S. Navy RAC
NWS - Earle, Colts Neck, N.J.

Figure 5
DCE Groundwater Plume
(Less than 17 feet depth)

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80 0 80 160 Feet

Source: Brown & Root, 1997 FS Report

U.S. Navy RAC
NWS - Earle, Colts Neck, N.J.

Figure 6
DCE Groundwater Plume
(17-35 feet depth)

6.0 SUMMARY OF PILOT TEST RESULTS

6.1 SVE TEST RESULTS

An AS/SVE pilot test was conducted at the site on May 18-19, 1999. The pilot test results were fully documented by FWENC in a June 14, 1999 submittal to the Navy entitled, *Air Sparge/Soil Vapor Extraction Pilot Test Report, Operable Unit No.3: Site 26* (FWENC, 1999). Figure 7 illustrates the layout/location of the wells utilized in the AS/SVE pilot test. A horizontal (trenched) SVE well was installed for the pilot test, in addition to a traditional vertical SVE well, due to concerns about the shallow depth to the water table. With the vertical well screened from approximately 3-8 feet bgs, significant water production (and screen blockage) could occur with applied vacuums of more than 30-36 inches of water.

The vertical SVE well (VE-1) was tested at various rates for approximately 3.5 hours on May 18, 1999. The horizontal well (VE-2) was tested for approximately one hour on May 19, 1999. VE-1 was retested for 0.5 hours on May 19 to see if overnight precipitation altered test conditions (due to increased soil moisture).

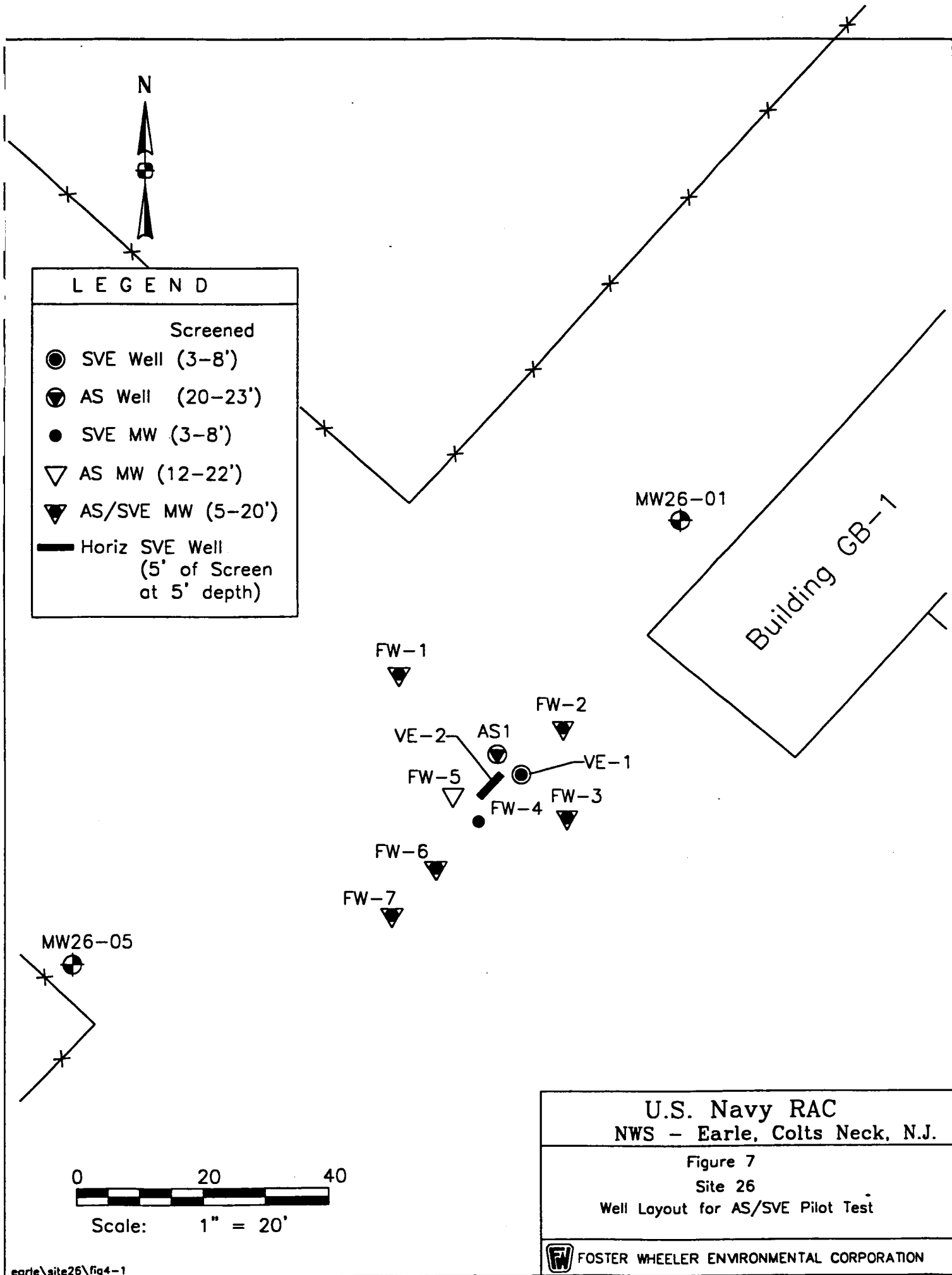
Analysis of data from VE-1 at 36 inches of applied vacuum, yielded a best-fit curve of induced vacuum versus radial distance based on a K_h/K_v ratio of 2.5. The effective radius of influence (ROI) for soil vapor extraction is typically between 0.1 and 1% of total well vacuum. Based on this rule-of-thumb, the ROI for Site 26 using vertical SVE wells is approximately 30 feet.

Analysis of data from horizontal well VE-2 resulted in a K_h/K_v estimate of 20, with a ROI of approximately 60 feet. The higher K_h/K_v ratio is a function of well construction (horizontal orientation). Consider the following points:

- The entire 5-foot length of screen at VE-2 is placed within a 6-8 inch thick horizon at 5 feet depth.
- The entire length of screen is open to air flow in the unsaturated zone, whereas some portion of the screen in the vertical well was likely being blocked off by upwelling waters from the shallow water table (especially at higher applied vacuum levels). The large open area at VE-2 resulted in lower applied vacuums and higher air flow rates.
- Placement of the plastic sheeting above the horizontal screen minimized short-circuiting of air flow from directly above, resulting in a higher proportion of lateral air flow.

6.2 AIR SPARGE TEST RESULTS

An air sparge test was conducted for approximately 3.5 hours on May 19, 1999. The vapor extraction blower was also operated during the sparge test to collect any VOCs volatilized by the sparging process. Since preliminary field observations indicated the horizontal VE well was more efficient than the vertical well, vapors were collected from VE-2 during the sparge test.



The pilot test results indicate sparging will have an asymmetrical ROI, extending 20-25 feet in a downgradient direction, but less than 10 feet in the upgradient direction. The asymmetrical shape of the sparge ROI is similar to that seen at another South Jersey Cohansey aquifer sparge site. Sparged air will follow the path of least resistance. In many cases, channeling will develop over time (one of several reasons to consider cycling/pulsing sparged air). The preferential downgradient ROI is likely a reflection of the sparged air following the path of least resistance (downgradient), due to the increased hydraulic head in the upgradient direction (local groundwater flow is toward the southwest).

VOCs were not detected in the extracted vapor stream during the sparge test. However, when the FID was inserted into the top of the wellhead at monitoring point FW-5 (screened only in the saturated zone), up to 27 ppm total VOCs were measured. The lack of VOC detections during this AS/SVE pilot test may be due to a significant amount of dilution occurring from short-circuiting atmospheric air flow.

6.3 RECOMMENDATIONS FOR FULL-SCALE DESIGN

The AS/SVE pilot test indicated the technology is viable for remediating groundwater contaminated with volatile organic compounds at Site 26. The radius of influence measured for vapor extraction and sparging at this site is typical for the type of geologic strata present.

Based on the pilot test results, the full-scale system should be designed using horizontal SVE wells, with an expected ROI of up to 60 feet for vapor extraction. Plastic sheeting (or other low permeability cover) should be placed directly above the trench-installed horizontal SVE well screens, to minimize short-circuiting of atmospheric air from directly above each well. The air sparge well network should be designed using the asymmetrical 10-25 foot ROI described above. Both the SVE and sparge well networks should be designed to eliminate/minimize stagnation zones, either by varying flow rates, or simply operating different wells at different times. The SVE network must be sized to fully capture the area impacted by sparged air.

Although VOCs were not detected in the extracted vapor stream during the pilot test, considering the TCE/DCE concentrations detected in groundwater and the significant amount of dilution that is likely to occur in the extracted vapor stream (unless the site is covered with a low-permeability cap/liner), use of vapor-phase granular activated carbon units (in series) will likely be the most cost-effective option for treatment of extracted vapors. If significant levels of vinyl chloride are detected in the extracted air stream, more aggressive treatment, such as thermal or catalytic oxidation, may be required.

7.0 PROJECT PLANNING/MANAGEMENT

Project Planning/Management activities include the preparation of pre-construction submittals, coordinating utility requirements, mobilization to the site, and providing home office support functions during the estimated period of performance. The subtasks involved in Project Planning/Management are described below.

7.1 PRE-CONSTRUCTION SUBMITTALS

Foster Wheeler Environmental will prepare and submit the following pre-construction documents to the Navy:

Work Plan

This Design/Work Plan presents Foster Wheeler Environmental's approach to executing the project, including the site description; background information on site hydrogeology; nature and extent of contamination; a summary of the AS/SVE Pilot Test results; project planning/management approach; permitting/reporting requirements; additional data needs; pre-construction activities; full-scale design specifications; QA/QC verification; waste removal requirements; project management; QA/QC control; and, sampling plans.

Health and Safety Plan (HASP)

A HASP for this program will be developed and submitted separately from this Design/Work Plan. The HASP will include Foster Wheeler Environmental's approach to providing for the health and safety of its employees for the duration of the project.

7.2 MOBILIZATION

Mobilization will consist of mobilizing personnel (FWENC and its subcontractors) and equipment to the site, and maintaining a small office trailer at the site. Mobilization activities shall also involve contacting appropriate Navy personnel at NWS Earle to arrange for contractor passes and to coordinate support requirements for installation of the AS/SVE system. A utility survey shall be conducted to determine the location of all utility lines within the Area of Concern (AOC). Utilities, primarily electric, shall be locked and tagged out, and/or terminated at the source. NWS-Earle Public Works personnel shall locate subsurface utilities. A dig permit shall be obtained prior to any drilling or excavation work. The Drilling subcontractor will obtain well permits from NJDEP. Arrangements will be made to enable the Drilling subcontractor to obtain water for drilling from appropriate/approved on-site sources.

The following personnel shall be notified at the Naval Weapons Station-Earle facility prior to the start-up of the field activities:

Base Civil Engineer:	Ext. 2317
Explosives Safety:	Ext. 2386
Security:	Ext. 2291
Ordnance Foreman (Frank Massa)	Ext. 2091
Bldg. FA-2	
Fire Department	Ext. 2260
Safety Department	Ext. 2624
Environmental Division	Ext. 2515 or 2062

7.3 HOME OFFICE SUPPORT

Foster Wheeler Environmental's Langhorne, Pennsylvania office will provide home office support for the duration of the project. Home office support includes the preparation of the required monthly progress, financial, and technical reports.

8.0 PERMIT AND REPORT PREPARATION/SUBMISSION

The following permits shall be completed and submitted in accordance to the applicable regulatory requirements.

8.1 AIR PERMIT

An air discharge permit shall be prepared and submitted to the NJDEP-Air Quality Permitting Program prior to the operation of the system. FWENC and the Navy will attend a pre-application meeting with NJDEP to discuss the pilot test results, and parameters to be used to obtain an air permit for the full-scale AS/SVE system.

The air permit application for the air sparge and soil vapor extraction system will be submitted to the NJDEP using the Air Information Management System (AIMS) electronic format. FWENC will perform a manual health risk assessment to ensure that the calculated health risk is less than one in a million for total toxic volatile organic compounds (NJDEP criteria). The risk assessment worksheet completed by FWENC may or may not be submitted to the NJDEP with the permit application. NJDEP will perform its own risk assessment and use it for the evaluation of the permit application. No health risk assessment using the dispersion model such as Industrial Source Complex (ISC) will be required. Upon receipt of the air permit application, the NJDEP requires approximately 90 days for review/approval.

*submit
only if
normal
require*

8.2 DIG PERMIT

Foster Wheeler Environmental shall contact the NWS-Earle Public Works Department to obtain a dig permit and have all utilities marked-out prior to drilling activities. Foster Wheeler will also contact the New Jersey Dig Safe, to clear additional utilities.

8.3 WELL PERMITS

Foster Wheeler will subcontract all drilling and well installation activities. The Drilling Subcontractor will be responsible for obtaining well permits from NJDEP for all wells proposed as part of the AS/SVE system.

9.0 ADDITIONAL DATA NEEDS

9.1 HYDROPUNCH/GROUNDWATER SAMPLING PROGRAM

Due to the time that has transpired since the 1995/96 Phase II Remedial Investigation, and the lack of measurable VOCs while installing and operating the AS/SVE pilot test wells, a confirmational groundwater sampling program is recommended prior to installation of the full-scale AS/SVE system. The primary objective of the sampling program will be to confirm the magnitude and extent of the TCE/DCE groundwater plume in the shallow aquifer. A secondary objective for this sampling program is to determine the presence and magnitude of any vinyl chloride that may exist in the shallow aquifer (presence of which could impact the recommended vapor-phase treatment option).

Confirmational groundwater sampling will be conducted using a combination of existing monitoring wells, wells installed as part of the AS/SVE pilot test, and additional HydroPunch sampling locations. Approximately sixteen (16) HydroPunch samples will be required; recommended HydroPunch locations are shown on Figure 8. In addition to the HydroPunch locations, groundwater samples will be collected from monitoring wells MW26-01, MW26-05, and MW26-06, as well as from the pilot test air sparge well, AS-1. Samples will be collected from the HydroPunch locations after driving the HydroPunch device to the base of the shallow aquifer (approximately 23-24 feet bgs). Groundwater samples will be obtained from the HydroPunch device using either a decontaminated small-diameter bailer, or a peristaltic pump and dedicated Teflon-coated tubing. Following collection of groundwater samples, all HydroPunch borings will be sealed to ground surface using a bentonite-cement grout. All hydro-punch locations and monitoring wells shall be surveyed by a New Jersey-licensed professional surveyor.

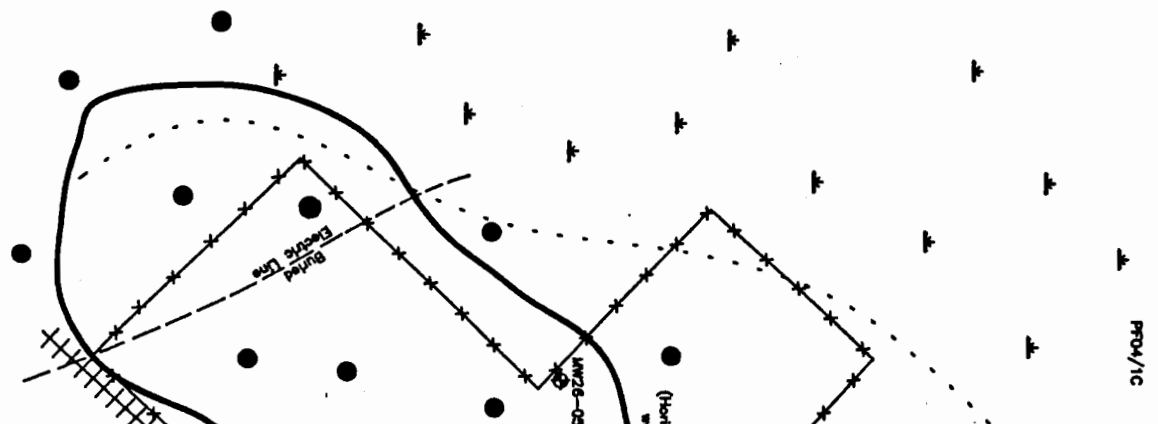
AS-1 is screened from 20-23 feet bgs. Samples will be collected from the existing monitoring wells and AS-1 (after purging with a decontaminated submersible pump), via double-check valve bailers, to ensure sampled water is retrieved from the lower portion of the shallow aquifer.

All groundwater samples (20) will be field analyzed for TCE, 1,2-DCE, and vinyl chloride via portable gas chromatograph. Six samples (including one duplicate, one field blank, and one trip blank) will be submitted to a fixed laboratory to confirm the field GC results. Appendix B contains the Sampling and Analysis Plan. In addition, groundwater samples collected from AS-1 and the three on-site monitoring wells will also be laboratory analyzed for total and dissolved iron and manganese.

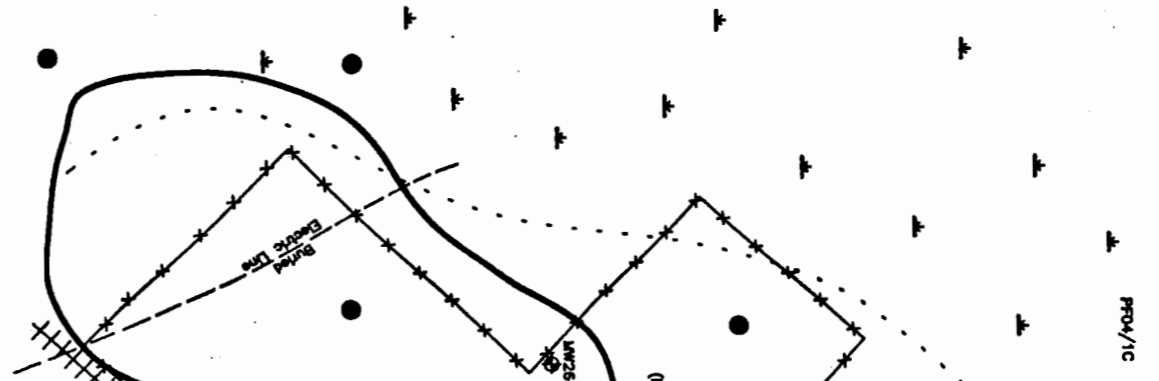
9.2 INSTALLATION OF ADDITIONAL MONITORING WELLS

Additional permanent monitoring wells will be required to adequately monitor site conditions during the AS/SVE remedial action. Figure 9 shows the proposed locations for seven (7) new peripheral monitoring wells (these locations may be revised pending results from the confirmatory groundwater sampling). The primary use for these wells will be to monitor

noynoc\scs\jha28\plumbosa.dwg



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groundwater conditions in the center and around the periphery of the existing TCE/DCE plume. Quarterly groundwater sampling from these wells (and three existing on-site monitoring wells) will provide data necessary to evaluate the effectiveness of the remedial operations and identify the onset of any plume expansion and/or downgradient migration during remedial operations. Appendix B contains the Sampling and Analysis Plan. One of the additional monitoring wells is located near the center of the southwestern (downgradient) half of the plume to assist in evaluating the progress of the AS/SVE remedial system.

Each of the newly-installed monitoring wells will be screened from 8-23 feet bgs, to allow monitoring across the entire thickness of the shallow water-table aquifer.

10.0 PRE-CONSTRUCTION SITE WORK REQUIRED

Prior to the installation of the AS/SVE treatment system on-site, the site will have to be prepared by the removal of some physical constraints. Any material and/or debris around the site that is determined to be a potential safety risk, or that will negatively impact the installation or operation activities, will be removed. These items include refuse, discarded construction materials, small plants, etc. Items that are questionable as to their use or necessity will be brought to the attention of the appropriate Navy personnel for the recommended course of action.

A large section of the existing chain-link fence will be removed to facilitate the installation of wells and the aboveground piping that connects the wells to the treatment building. The chain-link fence will be removed from the corner closest to the southwest corner of Building GB-1 to the southern-most corner of the chain-link fence. The fence will be staged on-site in an area that will not create a safety concern to pedestrian or vehicular traffic.

Building GB-01 shall be used to house the AS/SVE equipment. Two rooms on the southwestern side of Building GB-01 shall be modified in order to meet the needs of the AS/SVE system components. The 28 feet by 22 feet room accessible by the roll-up door at the loading dock shall be used to house the SVE equipment. The room immediately to the northeast shall be used to house the AS equipment. Since there is a potential for flammable gases from the extraction of air associated with the SVE system, the room that houses the SVE equipment shall be modified to be in compliance with Class I Division II Standards. The Class I Division 2 rating is only a precaution since the contaminated air shall be contained inside piping and treatment vessels. All of the existing electrical components and wiring inside the Class I Div. 2 room shall be removed. New Class I, Div. 2 electrical lines, conduit, lighting, ventilation and heating shall be installed in the room. A panel ceiling shall be installed overhead to seal off the top of the room. The existing doors shall be modified to ensure compliance with Class I Div. 2. The room that is going to house the AS equipment does not require the Class I Div. II rating since the AS equipment consists of blowers that shall be used to inject air into the aquifer.

11.0 AIR SPARGE/SVE DESIGN

11.1 WELL LOCATIONS

Figure 10 illustrates the proposed locations for the 72 sparge wells, 8 horizontal SVE wells, and 4 vertical SVE wells. The well types and locations have been determined based on results from the May 1999 pilot test (summarized above in Section 6).

11.2 WELL DESIGN

11.2.1 Sparge Wells

Two-inch diameter sparge wells will be installed using vibrasonic drilling techniques. Use of vibrasonic drilling to advance the boreholes will eliminate production of drill cuttings that would require subsequent waste characterization analyses and off-site disposal. Continuous soil samples will be collected from a small subset (approximately 10% of the wells, chosen in the field by the Site Geologist) of the sparge point locations to ensure an adequate understanding of the lithologic variations across the site.

Sparge well design is shown in Figure 11. Sparge boreholes will be advanced to a depth of approximately 23 feet bgs. A three-foot section of two-inch diameter 0.02-slot PVC screen will be set from 20-23 feet bgs. Riser pipe will consist of 2-inch diameter Schedule 80 PVC, extending 1-2 feet above grade. Morie #1 (or equivalent) sandpack will be installed to a depth of approximately 19 feet bgs. A two-foot bentonite seal will be installed above the sandpack, and the remainder of the annulus will be tremie-grouted using a bentonite-cement mixture. The riser pipe will be temporary capped with a 2-inch diameter PVC slip cap, pending hookups to the manifold sparge piping and associated wellhead assembly.

11.2.2 Horizontal SVE Wells

The eight horizontal SVE wells will be installed at a depth of approximately 5 feet bgs (Figure 12). A small backhoe will be used to excavate an eighteen-inch wide trench at each location. A 3-4 inch thick layer of Morie #2 sand (or equivalent) will be laid along the base of each trench prior to installation of the well screen and riser pipe. A fifteen (15) foot section of 4-inch diameter, continuous wound-wire PVC screen (0.03-slot) will be used at each horizontal well location. A 4-inch tee will be located in the center of the 15-foot long screen. The two ends of the screen will be capped and a 4-inch diameter Schedule 40 PVC riser pipe will extend 2-3 feet above the ground surface. The PVC riser will be connected to 4-inch diameter aboveground PVC piping, which will be manifolded to the treatment system blower(s). Aboveground piping from each SVE well will be installed such that it slopes slightly downward toward the well(s), to allow any condensation to drain back into the well(s). The sides and top of the well screen will be backfilled with Morie #2 sand to a depth of 3-4 inches above the screen. A 40-mil very flexible polyethylene (VFPE) geo-membrane liner will be laid atop the sandpack across the

AIR SPARGE WELL
W/ROI (10-25')

MONITORING WELL
LOCATIONS

WETLANDS

LEGEND

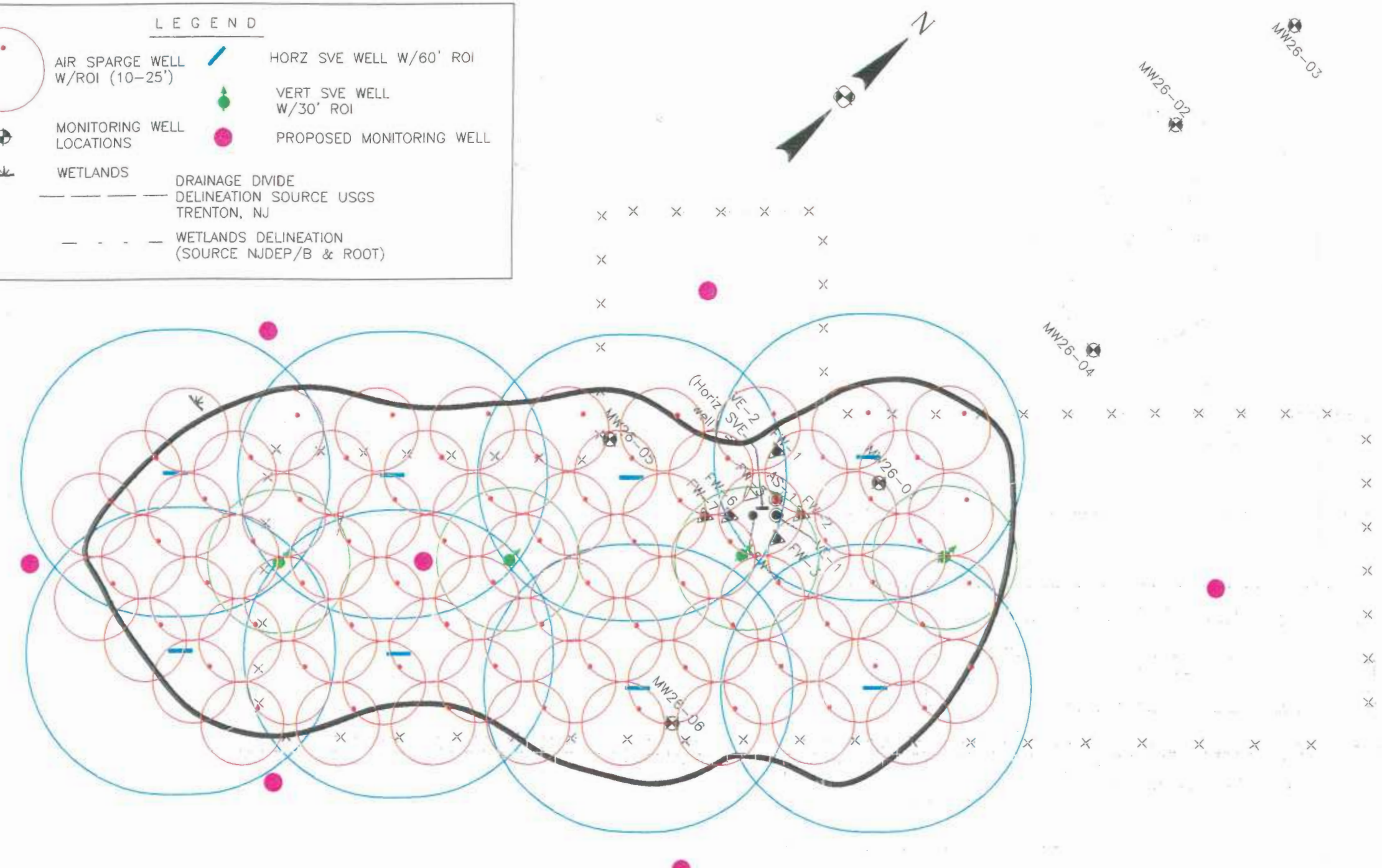
HORZ SVE WELL W/60' ROI

VERT SVE WELL
W/30' ROI

PROPOSED MONITORING WELL

--- DRAINAGE DIVIDE
--- DELINEATION SOURCE USGS
TRENTON, NJ

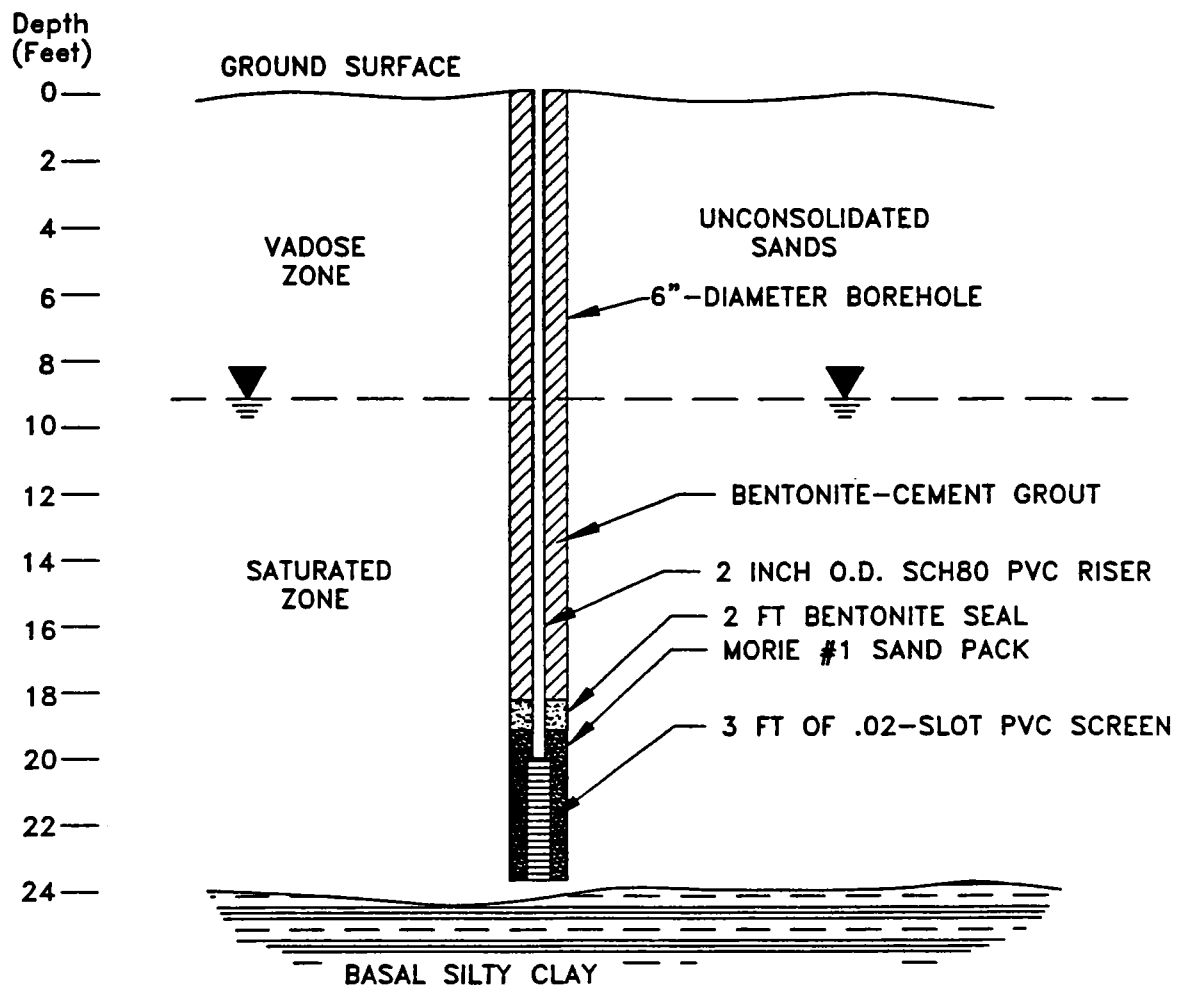
- - - WETLANDS DELINEATION
(SOURCE NJDEP/B & ROOT)



DEPARTMENT OF THE NAVY LESTER		NAVAL FACILITIES ENGINEERING COMMAND PENNSYLVANIA		FOSTER WHEELER ENVIRONMENTAL	
SEAL AREA 		Figure 10 NWS Earle, Colts Neck, NJ Well Locations for Full-Scale AS/SVE System		DATE DATE DATE	
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SPEC. NO. 04-		CONSTR. CONTR. NO.		NAVFAC DRAWING NO.	
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NWS - Earle, Colts Neck, N.J.

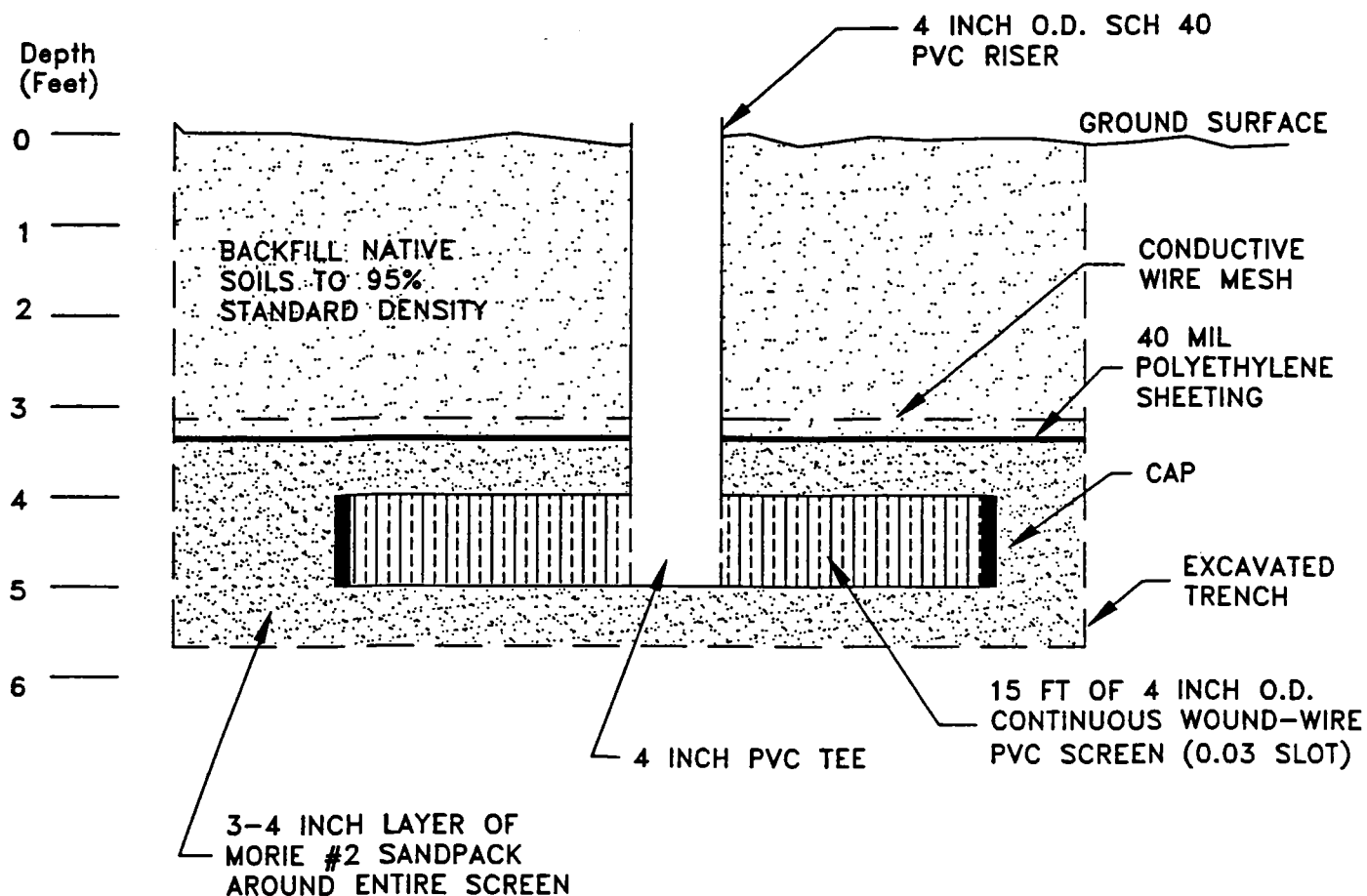
Figure 11
Well Construction Diagram
Drive-Point Sparge Wells



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NE

SW



NOTE:

TRENCH DIMENSIONS APPROXIMATELY 16 FEET LONG X 2 FEET WIDE X 5.5 FEET DEEP.

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NWS - Earle, Colts Neck, N.J.

Figure 12
Well Construction Diagram
Horizontal SVE Well

entire length/width of the trench to minimize “short-circuiting” of atmospheric air from directly above the SVE well screen. A length of conductive wire will be laid atop the sandpacked layer prior to backfilling with native soils. The wire will enable future workers to locate each buried horizontal well using standard metal detection devices. Native soils will be backfilled atop the geo-membrane to ground surface and compacted to within 95% of standard density.

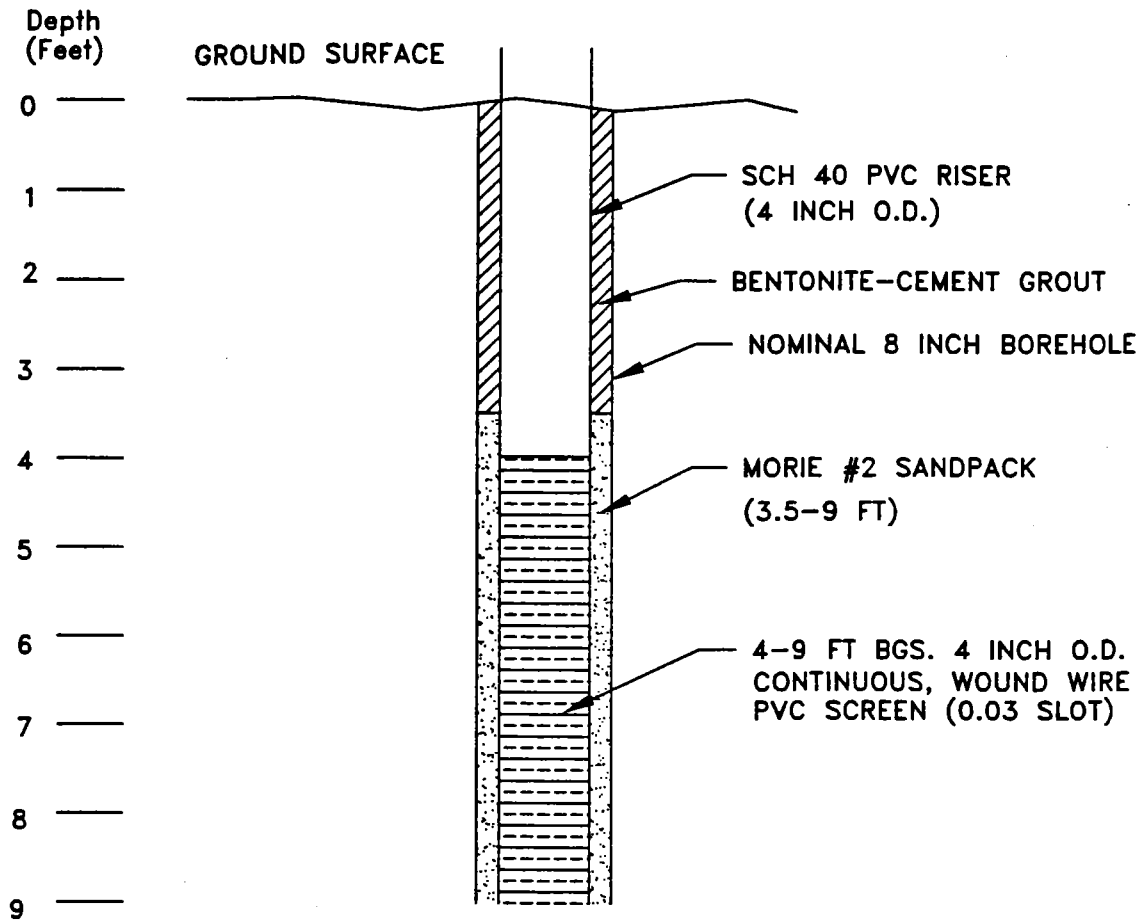
11.2.3 Vertical SVE wells

All vertical SVE wells will be installed using hollow-stem auger (HSA) drilling techniques. 8.25-inch augers will be used to drill the borehole for the 4-inch diameter SVE wells. The vertical SVE wells will be drilled to a depth of nine (9) feet bgs. A five-foot section of 0.03-slot continuous wound wire PVC screen will be installed from 4-9 feet bgs (Figure 13). Morie #2 sandpack will be installed in the annulus around the well screen and riser pipe to a depth of approximately 3.5 feet bgs. The remainder of the annulus will be sealed to ground surface using a bentonite-cement grout. The 4-inch diameter Schedule 40 PVC riser will extend 2-3 feet above grade and be connected to aboveground piping which will be manifolded to the treatment system blower(s). As with the horizontal SVE wells, all aboveground vapor extraction piping will be installed such that the piping runs slope downward toward the SVE wellhead, allowing any condensation to drain back into the well(s). To mitigate potential short-circuiting of atmospheric air, a 5-6 foot radius of plastic sheeting will be placed around each vertical SVE well, approximately 6-inches below grade.

All HSA drill cuttings will be containerized in DOT-approved 55-gallon drums. Each drum will be clearly marked as to the origin of its contents. Unsaturated/vadose zone soils will be containerized separately from saturated soils. All containerized soils will be sampled for waste characteristics to determine the appropriate disposal options. A Sampling and Analysis Plan is located in Appendix B.

11.3 PIPING LAYOUT

The piping networks shall be laid out aboveground. The underground approach is the normal method when the piping is located in an area that can not accept aboveground piping due to safety or regulatory restrictions, or if freezing issues are a concern. Underground piping is a more expensive approach since the soil must be excavated to install the piping. If the excavated soils exhibit high vapor concentrations or staining, then they would have to be sampled for waste characteristics and properly disposed. If the piping network is to be removed at the conclusion of the remedial action, then the underground piping would need to be re-excavated. Use of aboveground piping is more cost-effective because it can be both installed and removed at a faster rate, since it doesn't require soil excavation. In addition, since groundwater will not be extracted by the SVE system, freezing is of little concern. The condensate from the SVE piping can be handled by a combination of pitching the piping back toward the wells and controlling the applied vacuum to minimize moisture production in the extracted vapor stream.



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Figure 13
Well Construction Diagram
Vertical SVE Well

 FOSTER WHEELER ENVIRONMENTAL CORPORATION

The piping configuration into Building GB-01 is depicted in Figure 17. A small section of the concrete block wall shall be broken out to accommodate the piping. The annulus around the piping and the wall shall be sealed with hydraulic cement. The piping run under the loading dock shall be installed by removing sections of the concrete block wall, setting the pipe, and sealing the annulus around the pipe.

11.3.1 Soil Vapor Extraction Piping

The eight horizontal SVE wells and four vertical SVE wells have been divided equally into two groups to minimize head losses through the system. The groups were divided into north and south categories (see Figure 14). Each group contains four horizontal SVE wells and two vertical SVE wells that will be manifolded together and piped back to the treatment building. Both manifolds are combined to form a single stream prior to being split again before being connected to each SVE blower unit (see Figure 15). This piping configuration provides the most flexibility for the operation of the SVE blowers.

The SVE piping will be sized based on the volumetric flow rates determined during the AS/SVE pilot test and using an air velocity of 25 to 50 feet per second. This approach minimizes head losses through the piping while not over-sizing the piping. At the anticipated SVE flow rate of 2,240 standard cubic feet per minute, the piping will provide a total head loss of approximately 24 inches of water column (in. H₂O).

The SVE piping will be subjected to low vacuum pressures and very low concentrations of contaminants; therefore, several different piping materials can be used. The most cost-effective, chemically compatible materials would be either polyvinylchloride (PVC) or high-density polyethylene (HDPE). Either piping material could be used aboveground or underground.

Each SVE well (horizontal and vertical) will have a gate valve, vacuum gauge, air flow meter, temperature gauge and sampling port installed. The gate valve will provide flow adjustment capability for system balancing. The vacuum gauge will have a scale range of 0 to 50 in. H₂O. The temperature gauge provides a means to determine if the vapor stream is being short-circuited to the ground surface. The sampling port will provide a means to optimize system recovery by focusing on the wells, which contain higher vapor concentrations.

11.3.2 Air Sparge Piping

The seventy-two vertical AS wells have been divided equally into four groups to minimize head losses through the system. The groups will be divided into north, south, east and west categories (see Figure 16). Each group will contain eighteen vertical AS wells that are manifolded together and directed back to the treatment building. All four sparge manifolds will be combined to form a single stream prior to being split again before being connected to each sparge blower unit (see Figure 15). This piping configuration provides the most flexibility for the operation of the AS blowers.

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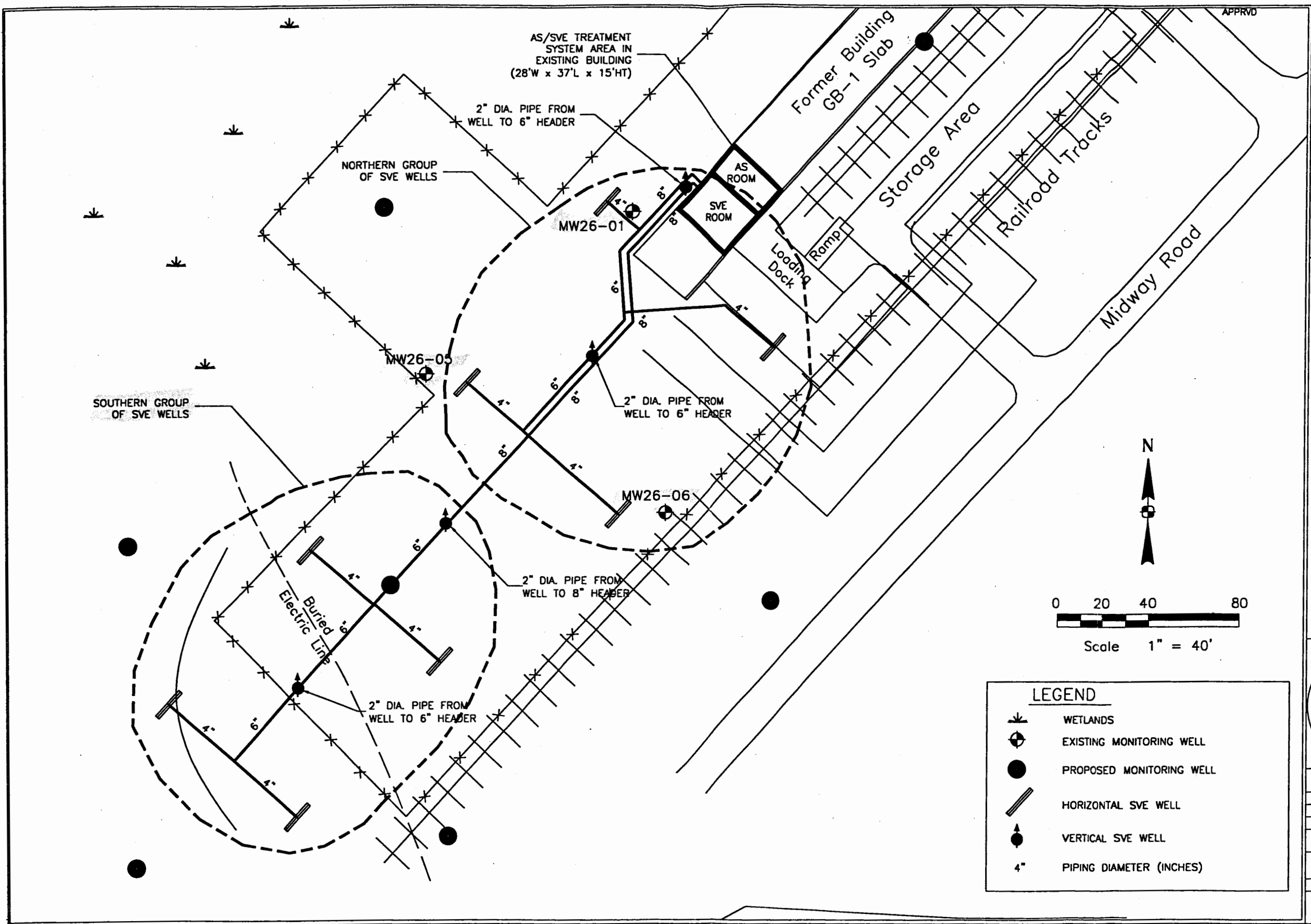
The SVE piping will be sized based on the volumetric flow rates determined during the AS/SVE pilot test and using an air velocity of 25 to 50 feet per second. This approach minimizes head losses through the piping while not over-sizing the piping. At the anticipated SVE flow rate of 2,240 standard cubic feet per minute, the piping will provide a total head loss of approximately 24 inches of water column (in. H₂O).

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The seventy-two vertical AS wells have been divided equally into four groups to minimize head losses through the system. The groups will be divided into north, south, east and west categories (see Figure 16). Each group will contain eighteen vertical AS wells that are manifolded together and directed back to the treatment building. All four sparge manifolds will be combined to form a single stream prior to being split again before being connected to each sparge blower unit (see Figure 15). This piping configuration provides the most flexibility for the operation of the AS blowers.



LEGEND

- WETLANDS
- EXISTING MONITORING WELL
- PROPOSED MONITORING WELL
- HORIZONTAL SVE WELL
- VERTICAL SVE WELL
- 4" PIPING DIAMETER (INCHES)

FOSTER WHEELER ENVIRONMENTAL	
DEPT. OF THE NAVY NORTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND PENNSYLVANIA NAVAL WEAPONS STATION - EARLE, COLTS NECK, NJ AIR SPARGE & SOIL VAPOR EXTRACTION SYSTEM - SITE 26 FIGURE 14: SOIL VAPOR EXTRACTION PIPING LAYOUT	DATE: _____ DESIGNED BY: _____ CHECKED BY: _____ SUBMITTED BY: _____ APPROVED BY: _____ DATE: _____ OFFICE IN CHARGE: _____ APPROVED: _____ DATE: _____
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CONSTR. CONTR. NO. N62472-94-D-0398	
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SHEET OF	
SIZE: B DES. SH. NO.	

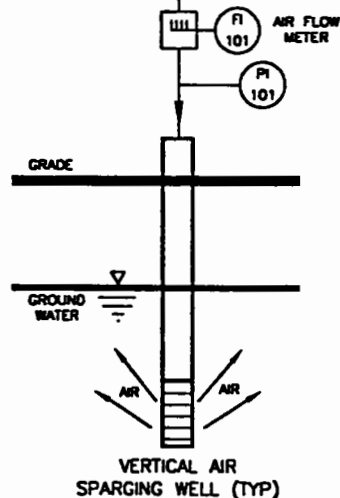
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TO AIR SPARGE WELLS
IN NORTH GROUP

TO AIR SPARGE WELLS
IN SOUTH GROUP

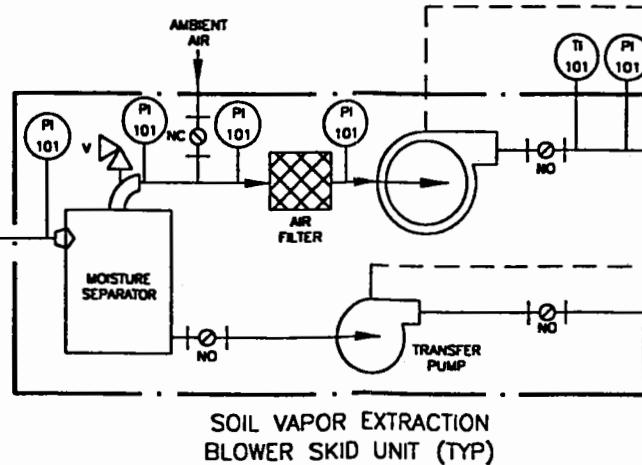
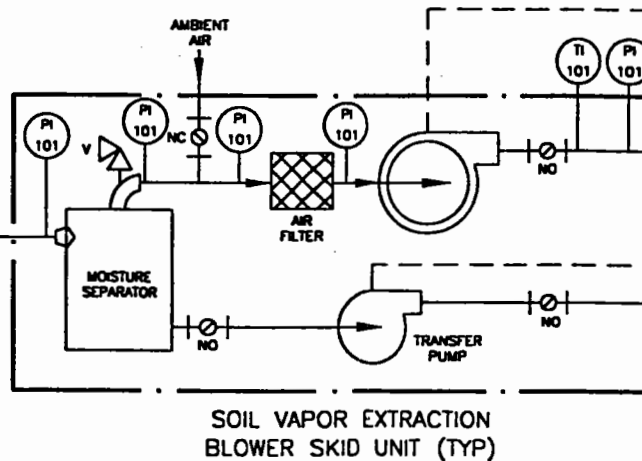
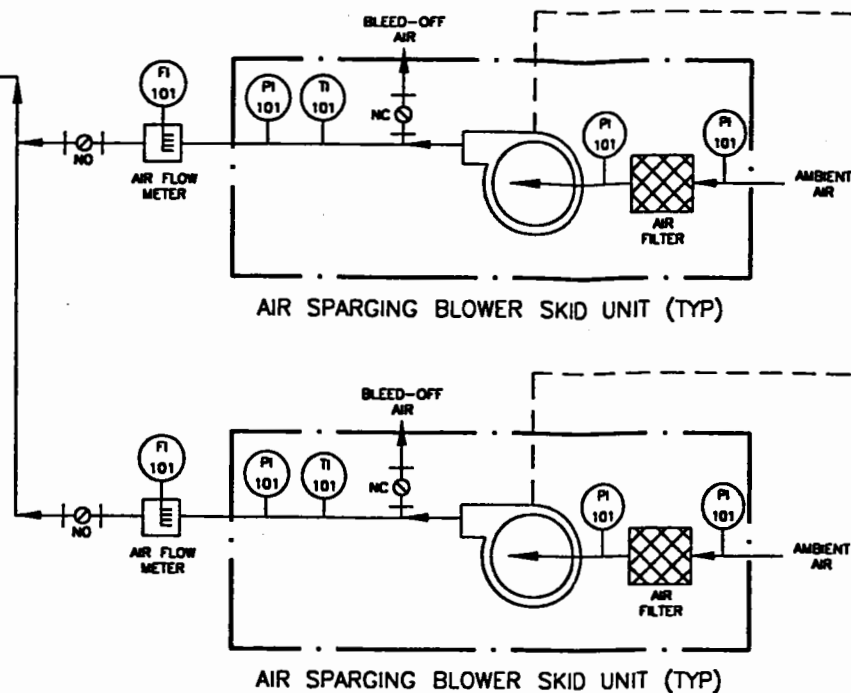
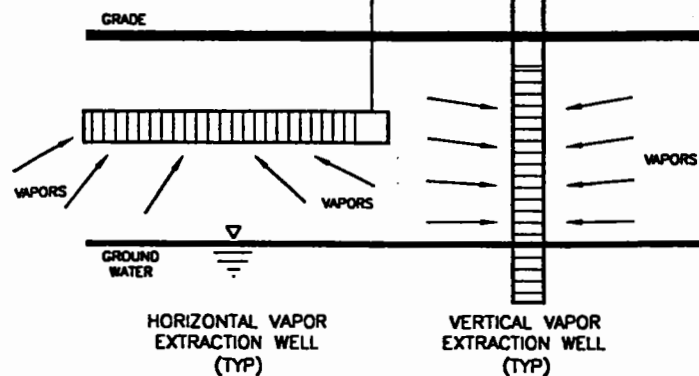
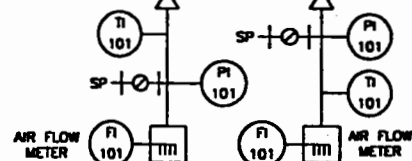
TO AIR SPARGE WELLS
IN EAST GROUP

TO AIR SPARGE WELLS
IN WEST GROUP



FROM SOIL VAPOR
EXTRACTION WELLS IN
NORTH GROUP

FROM SOIL VAPOR
EXTRACTION WELLS IN
SOUTH GROUP

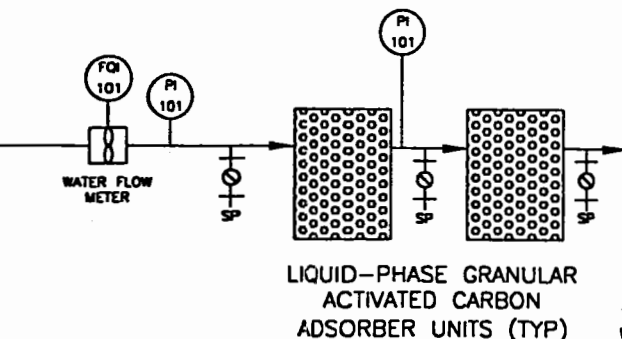
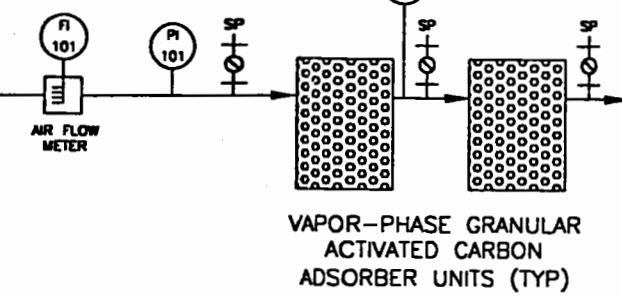


AMBIENT
L.E.L.
SENSOR IN
BUILDING

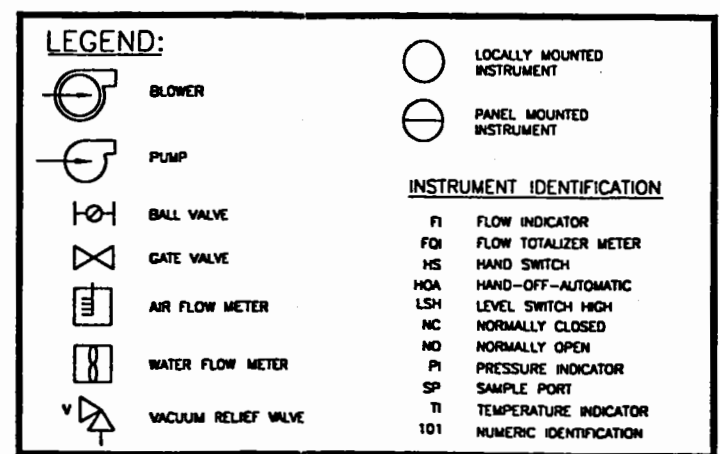
TELEMETRY
UNIT

CONTROL
PANEL

TREATED VAPOR
DISCHARGE TO
ATMOSPHERE



TREATED CONDENSATE
DISCHARGE



FOSTER WHEELER ENVIRONMENTAL

NAVAL FACILITIES ENGINEERING COMMAND

NORTHERN DIVISION

DEPARTMENT OF THE NAVY

LESTER

NAVY WEAPONS STATION - EARLE, COLTS NECK, NJ

AIR SPARGE & SOIL VAPOR EXTRACTION SYSTEM - SITE 26

FIGURE 15: PROCESS FLOW DIAGRAM

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DATE

CODE I.D. NO. 80091

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SPEC. NO. 04-

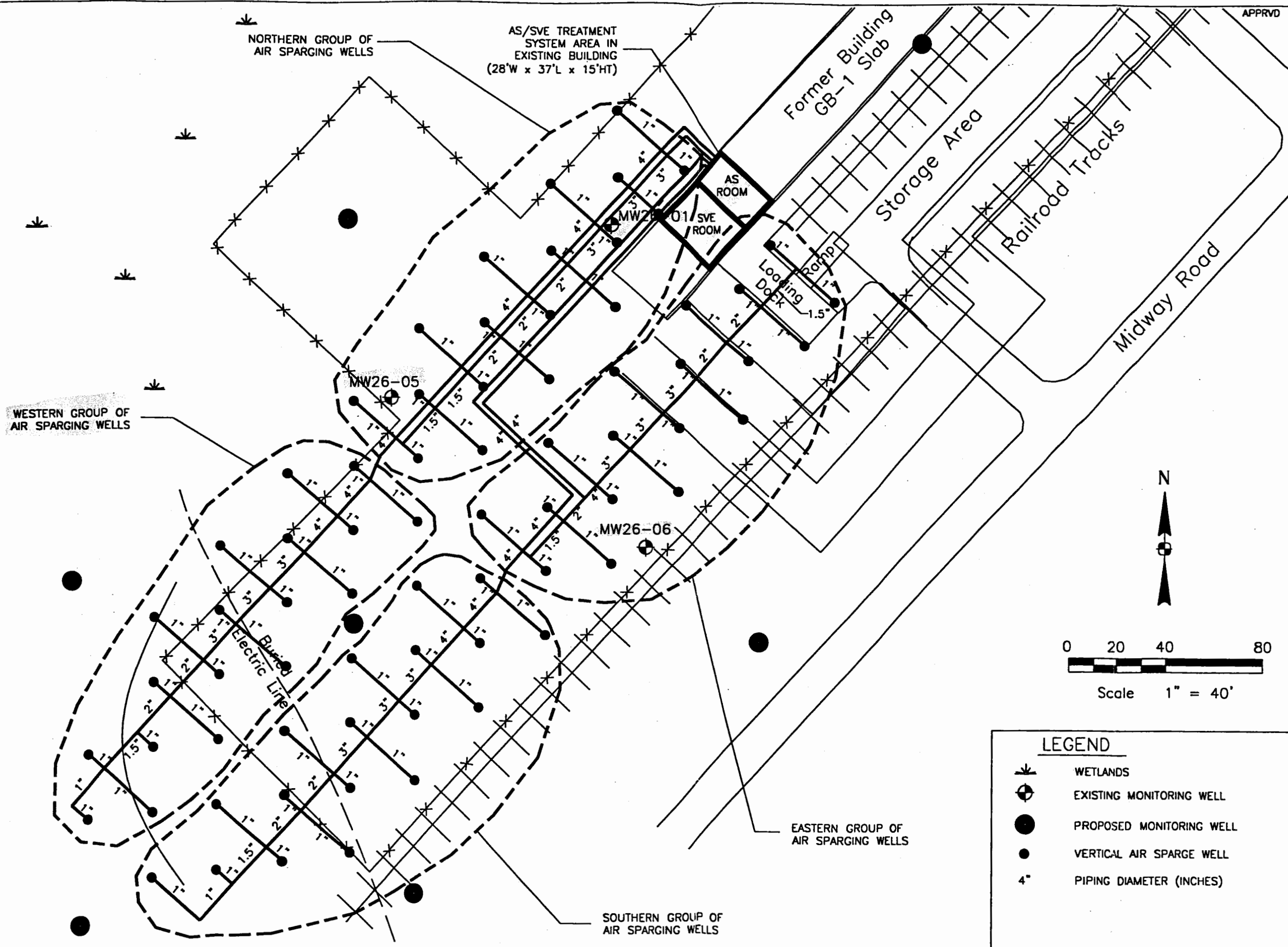
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FOSTER WHEELER ENVIRONMENTAL	
SUBMITTED BY: TRIM WELSH DATE: _____ APPROVED: _____ DATE: _____	NO. _____ DATE: _____ OFFICE IN CHARGE: _____ APPROVED: _____ DATE: _____
NAVAL FACILITIES ENGINEERING COMMAND NORTHERN DIVISION PENNSYLVANIA NAVAL WEAPONS STATION - EARLE, COLTS NECK, NJ AIR SPARGE & SOIL VAPOR EXTRACTION SYSTEM - SITE 26 FIGURE 16: AIR SPARGE PIPING LAYOUT	
DEPARTMENT OF THE NAVY LESTER	APPROVED: _____ DATE: _____ NORTHON FOR COMMANDER, NAVFAC
SEAL AREA 	
SAT TO	DATE
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SCALE:	N.T.S.
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CONSTR. CONTR. NO.	N62472-94-D-0398
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CAD FILE NAME: ASPPING
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The AS piping was sized based on the volumetric flow rates determined during the AS/SVE pilot test and using an air velocity of 25 to 50 feet per second. This approach minimizes head losses through the piping while not over-sizing the piping. At the anticipated total AS flow rate of 720 standard cubic feet per minute, the piping will provide a total head loss of approximately 1.0 psi. The AS piping will be subjected to low positive pressures, therefore, several different piping materials could be used. The most cost-effective and chemically compatible materials would be either high-density polyethylene (HDPE) or galvanized steel. Either material piping can be used aboveground or underground. Polyvinylchloride (PVC) piping could be used underground, but is not rated or recommended for carrying pressurized air aboveground. PVC piping has the potential to burst and send fragments similar to shrapnel through the air when not properly buried. Each AS well will have a gate valve, flow meter and pressure gauge installed. The gate valve will provide flow adjustment capability for system balancing. The flow meter will provide a means to regulate the quantity of air being directed down each well. The pressure gauge will have a scale range of 0 to 20 psi. The flow meter and the pressure gauge for each well shall be mounted inside of a NEMA 3R (or better) enclosure to protect the instruments from direct weather conditions (i.e. rain, sleet, snow, etc.). Each enclosure shall be secured to channel steel stakes driven into the ground next to each well.

11.4 SOIL VAPOR EXTRACTION SYSTEM

The SVE system will consist of two rotary lobe blowers connected and operating in parallel. Both blowers shall be connected to the SVE piping manifold network to facilitate operational flexibility. The extracted soil vapors will be directed from the SVE piping manifold network, and divided into two streams. Each stream will pass through a moisture separator, inlet filter/silencer, blower, outlet silencer, and then on to the off-gas control system. The processed vapor stream will be recombined after the outlet of the two blowers before proceeding to the off-gas control system.

11.4.1 Moisture Separator

A cyclonic-type moisture separator with a demister pad will be installed on each SVE blower skid. Each moisture separator shall be capable of handling a maximum flow rate of 1,250 scfm. Each moisture separator shall be equipped with a vacuum relief valve, condensate drain, and condensate transfer system (i.e. level controls and pump).

Any accumulated condensate in the moisture separator shall be automatically drained via a transfer pump (see Figure 15). Three level sensors shall be installed in a sight tube attached to the side of the moisture separator. The high and low level sensors shall turn the transfer pump on/off, and a high override (high-high) sensor shall turn off the SVE blower(s) to prohibit the moisture separator from overflowing and damaging the SVE blower. The water transferred from the moisture separator shall be treated through two liquid-phase granular activated carbon adsorbers plumbed in series prior to being discharged on-site. The treated condensate will be discharged to ground surface in an area that will not affect the operation or monitoring of the

AS/SVE system. The discharge line will consist of 20-foot long section of perforated 4-inch diameter schedule 40 PVC pipe placed over a 6-inch thick bed of 1½-inch stone. The stone is used to minimize soil erosion.

It is anticipated that there will be little condensate accumulation in the moisture separator due to the nature and operation of the AS/SVE system. The AS/SVE system is designed to minimize the amount of extracted condensate. In addition, the design of pitching the SVE piping back to each SVE well allows any condensate that accumulates in the piping network to drain back to the SVE wells.

11.4.2 Soil Vapor Extraction Blowers

Each of the two SVE blowers will be a Roots model URAI-615 or the equivalent. Each blower is capable of producing an air flow rate of 1,120 standard cubic feet per minute (scfm) at a vacuum of 100 in. H₂O. Each blower will be driven by a 40 horsepower motor operating on 460-volt, 3-phase power. The motors will be connected to the blower through an arrangement of belts and sheaves. The flow rate and vacuum that the blower will be initially set-up to operate at, can be modified by changing the sizes of the belts and sheaves. Each blower will be capable of operating independent of the (other for servicing needs).

Each of the blowers will be mounted on a steel skid with all associated appurtenances. Each skid unit will be equipped with a blower, motor, inlet filter/silencer, outlet silencer, air flow indicator, high outlet temperature override sensor/switch, temperature gauge, pressure gauge, vacuum gauges and a locally mounted motor disconnect switch. The motor starter relay and thermal overload protection switch for both blowers will be mounted in the control panel. All electrical wiring, switches, sensors, junction boxes, conduit, etc. will be rated to operate in a Class I, Division 2, Group D environment.

11.5 AIR SPARGING SYSTEM

The AS system will consist of two rotary lobe blowers connected and operating in parallel. Both blowers will be connected to the AS piping manifold network to facilitate operational flexibility. Ambient air from outside the building will pass through an inlet filter/silencer, the blower, outlet silencer and then on to the AS piping manifold network. The compressed air stream from each blower shall be combined before proceeding to the AS piping manifold network.

Each of the two AS blowers shall be a Roots model URAI-65 or the equivalent. Each blower shall be capable of producing an air flow rate of 360 standard cubic feet per minute (scfm) at a pressure of 12 pounds per square inch (psi). Each blower will be driven by a 40 horsepower motor operating on 460-volt, 3-phase power. The motors will be connected to the blower through an arrangement of belts and sheaves. The flow rate and pressure that the blower will be initially set-up to operate at, can be modified by changing the sizes of the belts and sheaves. Each blower will be capable of operating independent of the other (for servicing needs).

Each of the blowers will be mounted on a steel skid with all associated appurtenances. Each skid unit will be equipped with a blower, motor, inlet filter, inlet filter/silencer, outlet silencer, air flow indicator, high outlet temperature override sensor/switch, temperature gauge, pressure gauges, vacuum gauge and a locally mounted motor disconnect switch. The motor starter relay and thermal overload protection switch for both blowers will be mounted in the control panel.

11.6 TREATMENT SPECIFICATIONS FOR EMISSIONS

There will be two emission streams of concern for the AS/SVE system; the off-gas from the SVE system, and any condensate collected in the moisture separator(s).

11.6.1 SVE Off-Gas Control Specifications

The off-gas from the SVE system must be treated prior to discharge to the atmosphere. There are two options under consideration to satisfy this requirement: (1) vapor-phase granular activated carbon (VGAC) and (2) thermal or catalytic oxidation. The VGAC units are simply operated by passing the extracted vapor stream through the VGAC containers, which adsorb the hydrocarbons. Periodic monitoring determines when the VGAC in the vessels is "spent", whereby, the carbon media is replaced with new media. Typically, VGAC units are operated in series to ensure VOCs do not exceed permitted levels. The "spent" media is transported off-site for proper disposal/regeneration. Thermal catalytic oxidizers oxidize the hydrocarbons in the vapor stream via thermal incineration. The oxidizers use the heat of reaction of the vapor stream, along with a supplemental fuel, to raise the vapor stream temperature to a level where oxidation can occur. The supplemental fuels commonly used with oxidizers are propane, natural gas or electricity.

Thermal catalytic oxidation units are generally used when sustained vapor stream concentrations are greater than 200 parts per million, volume basis (ppmv). The lower the vapor-stream concentration, the more supplemental fuel the oxidizer must use to provide adequate destruction efficiency. Oxidizers are also used when it is determined that the vapor stream contaminants may adversely react with vapor-phase granular activated carbon.

Another detriment to using an oxidizer for off-gas treatment of a vapor stream that contains chlorinated hydrocarbons is that they produce acid-gas byproducts. The acid-gases must be treated prior to their discharge to the atmosphere by passing the oxidizer effluent stream through a scrubbing unit. The acid-gases dissolve into the scrubber's water droplets and are collected in the unit's sump. The scrubber's sump water is then typically treated via liquid-phase granular activated carbon (LGAC) before being discharged.

The vapor stream concentration from the Site 26 SVE system is anticipated to be 50 ppmv and it is not anticipated to contain contaminants that will adversely react with vapor-phase granular activated carbon. Based upon the anticipated vapor stream concentrations, the usage rate of the vapor-phase carbon is estimated to be 6,833 pounds per month. However, since the treatment system is only anticipated to operate 8 hours per day, 5 days per week the actual carbon usage

rate reduces to 1,642 pounds per month. The use of vapor-phase granular activated carbon for off-gas treatment is recommended. Effluent concentrations and carbon usage will likely decline exponentially during the first 2 to 3 months of operation.

11.7 ELECTRICAL CONTROL SPECIFICATIONS

All electrical equipment delivered to the site, which has not been pre-wired by the manufacturer, will be wired by a licensed electrician. All equipment, materials, panels, etc. shall meet the appropriate rating for each application as defined in the National Electric Code (NFPA 70).

11.7.1 Electrical Power Supply and Distribution

The existing electrical service into Building GB-01 is 120/240-volt 3-phase delta, rated for 200 amps. In order to power all the appropriate blowers and pumps, the power needs to be modified to 3-phase 480-volt. An overhead high voltage primary electrical line shall be run from the existing electrical pole, located north of Building GB-01, on the opposite side of Macassar Road. The overhead primary line shall be run from the existing pole, over Macassar Road, to newly installed pole adjacent to Building GB-01. Three 75KVA transformers, and primary fuse cut-outs, shall be mounted to the newly installed pole adjacent to Building GB-01. The 480 volt secondary electrical line shall be run from the pole, along the outside of Building GB-01, to the southwestern side of the building where the AS/SVE Units will be housed. The 480 volt secondary service electrical line shall run to a Main Disconnect switch mounted on the outside of Building GB-01. The electrical service shall run into a 3-phase 300 amp Main Service Panel mounted on the inside of Building GB-01. A transformer shall be installed between the Main Service Panel and a 100 amp 120/240 volt panel. The Starter and Control Panels shall be installed adjacent to the other panels inside Building G B-01. The distribution panel will have a dedicated circuit breaker for each motor used in the AS/SVE system. Additional circuit breakers will be used for the system control panel, lighting, heating, ventilation, and two convenience receptacles. All exterior mounted devices will be rated NEMA 3R weather-proof to protect against weather conditions.

11.7.2 System Control Panel

The control panel will be constructed to remotely operate all of the motors associated with the AS/SVE system on a Programmable Logic Control (PLC) type system. The control panel will be located on the inside of Building Gb-01 adjacent to the electrical distribution panel. The control panel will have a lockable dead-front door to prevent system damage, and shall be rated for interior use. The control panel will contain the motor starter relays and thermal overload protectors for all of the motors in the AS/SVE system. In addition, the control panel will contain intrinsically safe relays and zenar barriers from all of the sensors/switches in the AS/SVE system; hand-off-automatic switches for all motors; indicator lights; alarm lights; voltage transformer; and, an internal fax modem for remote operation of the telemetry system. All computerized system controls will be Y2K-compatible.

The control panel will be wired and configured for the automatic operation of the AS/SVE system. All alarm conditions shall turn the system off, which shall require a manual on-site restart by trained personnel. The telemetry system shall provide a remote system access for status and operation. The computer program to access the telemetry system shall be Microsoft® Windows® based. The telemetry system shall be capable of turning motor(s) on/off, monitoring flow rates, system operational times, etc. A telephone/data cable shall be installed and connected to the control panel's fax modem to facilitate the operation of the telemetry system.

Each blower skid unit shall be equipped with a power disconnect switch to provide an additional fail-safe mechanism. Each blower can also be de-energized via a switch at the control panel, the breaker at the distribution panel, or by turning off the main breaker.

11.8 BUILDING GB-01 TREATMENT ROOMS

The AS/SVE equipment will be housed within Building GB-01. The two rooms immediately inside Building GB-01, accessible from the loading dock, shall be used to house the AS/SVE equipment. Figure 17 depicts the layout of the AS and SVE Rooms inside Building GB-01. The room that houses the Soil Vapor Extraction (SVE) equipment shall comply with the requirements for a Class I, Division 2, Group D environment. The electrical distribution panel and control panel shall be mounted on the inside of Building GB-01, but outside the Class I Division 2 room. Most of the treatment equipment will be delivered pre-assembled and pre-wired, therefore, final piping and electrical connections will be minimized. Additional lighting, ventilation, and heating shall be installed inside the two rooms being utilized inside Building GB-01. All electrical components (lighting, heating, etc) in the SVE room shall comply with the requirements for a Class I, Division 2, Group D environment.

The use of VGAC is an acceptable means of off-gas treatment from a SVE system provided the carbon system is sized for a minimal removal efficiency of 99%. The carbon treatment system will be monitored in accordance with the approved air permit. Typical monitoring requirements include the use of a PID or FID to measure the volatile organic compound level prior to, between, and after the carbon units. The monitoring is typically performed three times during the first week, once per week for the remainder of the first month of operation and once per month thereafter.

12.0 CLEANUP GOALS

The New Jersey Ground Water Quality Standards (NJ-GWQS) for trichloroethene and 1,2-dichloroethene are 1 ug/L and 100 ug/L, respectively. The cleanup goal for the Site 26 AS/SVE remediation will be to reduce the TCE/DCE concentrations to NJ-GWQS's. Using AS/SVE technology, extracted contaminant concentrations typically peak during the first few weeks of operation, then decline exponentially for the next several weeks-to-months, before reaching asymptotic levels within 12-24 months of operation.

Contaminant concentrations in groundwater will be monitored (and reported) periodically (quarterly) during active operation of the AS/SVE system. As extracted VOCs reach asymptotic levels, the AS/SVE system will be operated more intermittently, while FWENC/Navy staff evaluate plume conditions for "rebound". "Rebound" refers to situations where contaminant concentrations in groundwater (and/or the extracted vapors) increase after the remedial system has been inactive (shutdown) for an extended period of time. Rebound occurs due to diffusion-limited reactions, and the presence of residual (immobile) contaminant and stagnation zones. Operating intermittently, and/or at varying flow rates should minimize the magnitude and duration of any rebound effects.

The Site 26 AS/SVE system will continue to operate (at least intermittently) until extracted VOCs reach asymptotic levels with no significant rebound effects and groundwater concentrations are below State criteria. If concentrations in groundwater are still above State criteria at that time, and it is no longer cost-effective to operate the AS/SVE system, fate and transport modeling will be conducted to evaluate the potential for the remainder of the contaminant plume to naturally attenuate before reaching any downgradient receptors. In this case, the Navy would propose a revised Record of Decision for monitored natural attenuation of the residual compounds.

13.0 OPERATION & MAINTENANCE

The air sparging and SVE system will be designed and installed to operate unattended on a 24-hour basis. However, it is understood that the system will only be operated (initially) for the 8-hour per day shift that personnel are working in the area. The system will require periodic visits by FWENC personnel to monitor the operation and make adjustments to optimize system performance. Site visits will be conducted once per week to record vacuum/pressure readings, flow rates, vapor stream concentrations and to perform system maintenance as necessary. The system will also be capable of remote monitoring via the telemetry system. The telemetry system shall be used to check the operation of the treatment system on a daily basis. An alarm condition(s) shall activate the telemetry system and send a fax report to a preprogrammed number(s). An Operation and Maintenance (O&M) Manual will be submitted detailing the O&M operations and sampling and analysis information with regards to system operations.

13.1 SYSTEM OPERATION

The SVE system is intended to establish and maintain a vacuum gradient across the area of concern. The vacuum gradient ensures that any vapors existing in the unsaturated zone (specifically those volatilized during air sparging operations) are collected, treated, and safely discharged. Monitoring wells in and around the area of concern will be monitored for vacuum levels and the presence of vapors. The air sparge system can be operated in a continuous or pulsed operation. Pulsed operation is the industry standard for best results; however, the frequency of on/off operation varies somewhat from site to site.

The area of concern is divided into two groups of SVE wells (north & south). Each of the two SVE groups is divided into four air sparge groups (north, south, east & west). Initially, the AS/SVE system north group will operate for one week while the south group remains off. The following week will employ the opposite set of wells. This schedule of alternating the SVE groups will be followed until modifications are necessary. The operation of air sparge wells will be on a per group basis and modified as necessary. The SVE system shall be operated whenever the air sparge system is operated, and should be operated for 1 to 2 days following the sparge system operation to prevent vapor accumulation or migration.

13.2 BLOWER MAINTENANCE

Both the air sparge system and SVE system consist of two rotary lobe blowers each. Each rotary lobe blower requires the level of lubricating oil to be properly maintained. The oil in the rotary lobe blowers is generally changed-out once per month, if the blower is continuously operating. Care must be taken to ensure that moisture is not introduced to the rotary lobe blowers. If moisture is introduced to the blower(s), rust can quickly form and damage the highly polished lobes. The air filters shall be periodically inspected and cleaned/replaced as necessary.

13.3 VAPOR-PHASE CARBON CHANGE-OUTS

The VGAC adsorbers are used to remove VOCs from the vapor stream and shall be monitored in accordance with the Air Permit. The VGAC units are commonly used in pairs and plumbed in series. By operating the VGAC units in series, the effluent of the first unit can be monitored to determine the length of time for breakthrough to occur. This time is used to calculate the carbon usage rate (to estimate the "life" of the second unit) and arrangements can be made to change-out the carbon, while the second unit adsorbs the VOCs and maintains Air Permit compliance. In addition, the second carbon unit acts as a backup to maintain Air Permit compliance if influent vapor concentrations increase dramatically and breakthrough the first unit much sooner than anticipated.

It is anticipated that periodic vapor stream samples will be collected to provide proof of Air Permit compliance. Vapor samples will be collected from sampling ports located before, between, and after the two VGAC units (see Figure 15). In addition, vapor stream monitoring with a field instrument containing either a photoionization detector (PID) or flame ionization detector (FID) will be required by the Air Permit. The field instruments provide real-time data to determine if breakthrough of the VGAC unit(s) has occurred. Carbon breakthrough is defined as when vapor concentrations in the effluent stream of the VGAC unit(s) is 10 ppmv or greater (based upon the minimum detection limit of the field instrument).

The VGAC units shall be changed-out when it is determined that breakthrough has occurred by the above-described methods. The treatment system will be temporarily turned off to facilitate the removal of the "spent" carbon and the subsequent disposal/regeneration of the carbon by an approved licensed contractor. The carbon will be tested to determine whether its characteristics are hazardous or non-hazardous. Once the spent carbon is removed, the vessels will be refilled with new carbon and the treatment system can be restarted.

13.4 LIQUID-PHASE CARBON CHANGE-OUTS

The LGAC adsorbers are used to remove VOCs from the collected condensate in the moisture separators. The LGAC units are commonly used in pairs and plumbed in series. By operating the LGAC units in series, the effluent of the first unit is monitored to determine the length of time before breakthrough occurs. This time is used to calculate the carbon usage rate (to estimate the "life" of the second unit) and arrangements can be made to change-out the carbon, while the second unit adsorbs the VOCs and maintains permit compliance. In addition, the second carbon unit acts as a backup to maintain permit compliance if water concentrations increase dramatically and breakthrough the first unit much sooner than anticipated.

The LGAC units shall be monitored periodically for any breakthrough of VOCs. Water samples shall be collected from sampling ports located before, between, and after the two LGAC units (see Figure 15).

The LGAC units shall be changed-out when it is determined that they have become spent by the above-described methods. The carbon will be removed and disposed/regenerated by an approved licensed contractor. The carbon will be tested to determine whether its characteristics are hazardous or non-hazardous. Once the spent carbon is removed, the vessels will be refilled with new carbon. The treatment system does not need to be turned off to perform this change-out; the condensate transfer pumps are temporarily deactivated while the change-out occurs.

14.0 WASTE REMOVAL/REGULATORY COMPLIANCE

This section addresses how the waste streams generated during the Site 26 AS/SVE installation will be handled. These waste streams include investigation-derived waste (IDW) such from drill cuttings, groundwater, and PPE.

14.1 INVESTIGATIVE DERIVED WASTE (IDW)

Composite samples of drill cuttings from the vertical SVE boreholes will be sampled and analyzed for waste characterization as part of the well installation program. One composite soil sample shall be collected and analyzed in accordance to the Sampling and Analysis Plan located in Appendix B. This data will be used to classify the soil cuttings for disposal purposes. Depending upon classification, investigation derived wastes will be disposed of in accordance with NJDEP solid waste and/or Hazardous Waste Regulations. It is anticipated that the soils generated will be non-hazardous, but a description of waste handling practices for both waste streams is discussed.

All groundwater produced during well installation and development will be containerized in DOT-approved 55 gallon drums. The extracted groundwater will be treated on-site with a bag filter and two activated carbon units in series.

Other IDW such as decontamination fluids, PPE, decon pad materials, etc. will be collected and stored separately in 55-gallon drums. These materials will be classified for disposal based on the results from soil and groundwater sampling.

14.2 MANIFESTS/SHIPPING PAPERS

Foster Wheeler Environmental shall provide completed Waste Manifests and/or Bills of Lading and transport documentation to the Navy for review and signature.

14.3 WASTE TRANSPORT AND DISPOSAL

Foster Wheeler Environmental shall subcontract for waste transport and disposal (T&D) services. The T&D subcontractor shall be competitively procured from firms with which Foster Wheeler Environmental has pre-placed basic ordering agreements. This assures the Navy that solid and/or hazardous wastes will be sent to an EPA NJDEP-approved facility. All disposal facility transporters for both hazardous and solid waste, to be used for disposal of the Navy's wastes, will be evaluated for regulatory compliance and approved for use in accordance with Foster Wheeler Corporation Regulatory Compliance Procedures. Approved facilities and transporters will be submitted to the Navy for final approval. Mr. Dennis Swalwell at Ext. 2339 will be notified of the number of drums generated during the field activities as well as the location of the drum staging area.

The transportation and recycling of wastes generated during the operation of the AS/SVE system shall be addressed in the Operation and Maintenance Plan.

14.4 HAZARDOUS WASTE MANAGEMENT

RCRA regulated hazardous wastes, if present, will be placed into appropriate DOT approved containers for disposal. FWENC will prepare Waste Profiles, Hazardous Waste Manifests, LDR Notification Forms and other shipping documentation for Navy review and signature prior to off-site disposal. Copies of certified weight tickets, TSDF signed manifests and all disposal documentation documents will be forwarded to the Navy.

If on-site storage of hazardous wastes is required, the proposed hazardous waste storage area will meet generator requirements for less than 90-day storage of hazardous waste as per 40 CFR 262.34:

- All stored hazardous wastes will be removed from the project site for off-site disposal within 90 days of first being accumulated.
- Each container will be marked with the date on which the accumulation period begins.
- All hazardous waste storage areas will be marked with signs stating "Hazardous Waste."

- For waste containers containing free liquids, the container storage areas will have a containment system capable of collecting and holding spills, leaks and precipitation. The containment system shall have an impervious base underlying the containers, which is free of leaks, gaps or cracks. The capacity will be sufficient to contain the entire volume of the largest container or 10% of the entire volume of all of the containers whichever is largest. Run on into the containment system will be prevented. Spilled or leaked waste and accumulated precipitation will be removed from the containment system in as timely a manner as necessary to prevent overflow of the containment system.
- For waste containers, which do not contain free liquids, a secondary containment system will not be provided, however the storage area will be designed and operated to drain and remove liquid resulting from precipitation or the containers will be elevated and removed from contact with accumulated precipitation.
- Containers holding reactive or ignitable waste will be stored at least 50 feet (15 meters) from the property line.
- Each container of hazardous waste will be marked and labeled in accordance with US DOT requirements under 40 CFR 172.
- Hazardous Waste Containers will meet US DOT requirements under 40 CFR Parts 173, 178, and 179.
- Each container of hazardous waste of 110 gallons or less will be marked in accordance with US DOT requirements under 49 CFR 172.304 with the following:

HAZARDOUS WASTE-FEDERAL LAW PROHIBITS IMPROPER DISPOSAL. If found contact the nearest police or public safety authority or the Environmental Protection Agency.

Generator name and Address _____

Manifest Document Number _____

- Waste will be placed in containers in good condition. If container begins to leak, the contents will be transferred from the defective container into a good container.
- The containers used will be made of, or lined, with a material that does not react with and is compatible with the waste.
- The containers shall remain closed during storage, except when waste is added or removed from the container.
- The containers will not be opened, stored, or handled in a manner, which will cause the container to leak.

- The containers will be labeled to accurately identify their contents.
- The storage area and containers will be inspected at least weekly to identify leaks and/or deterioration. Inspection reports will be documented in writing.
- Incompatible wastes will not be placed within the same container or in an unwashed container that previously held an incompatible waste or material.
- A container holding a waste that is incompatible with other wastes or materials will be segregated from the other materials or protected by means of an impermeable dike, wall, berm or other device.
- Upon project closure, all hazardous waste and hazardous waste residues will be removed from the containment system. The containment system will be decontaminated and all wastes will be disposed off-site at a permitted disposal facility.
- Appropriate hazardous training will be provided to site personnel as per 40 CFR 265.16.
- A Contingency Plan will be developed to handle any fire, spill, or emergency and appropriate emergency response equipment (spill cleanup materials, fire protection equipment, communication devices and alarms to notify workers of an emergency are) and will be present as required under 40 CFR 265 Subparts C & D.

14.5 SOLID WASTES

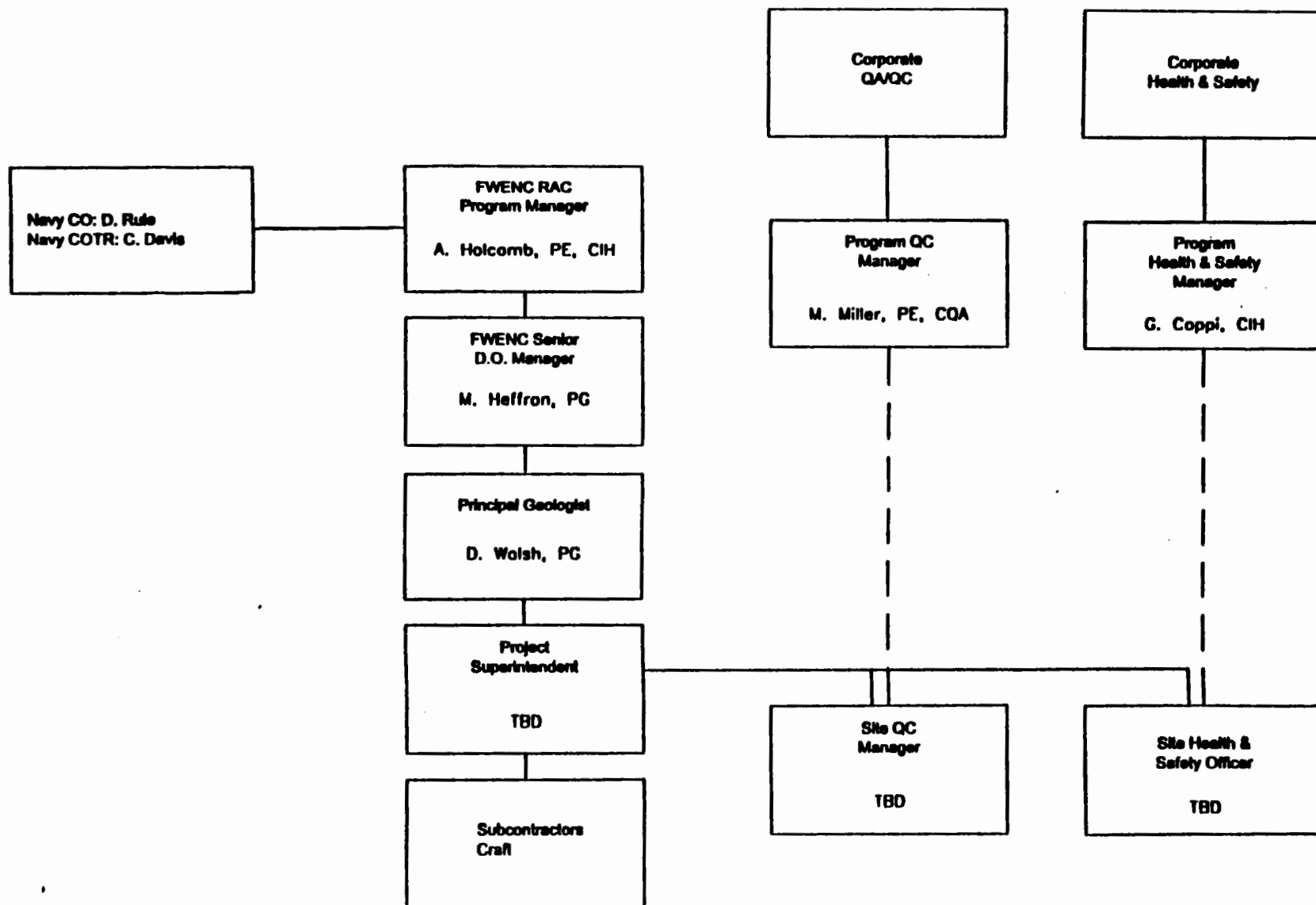
All non-hazardous solid wastes generated on-site will be disposed of or recycled in accordance with all applicable Federal and State Laws.

15.0 QA/QC VERIFICATION OF FIELD SAMPLING AND PROCEDURES FOR FIELD CHANGES AND CORRECTIVE ACTION

15.1 QA/QC AUDITS

Quality assurance and quality control during the sampling program will be performed by the Foster Wheeler Environmental Project Superintendent (PS). The PS will supervise all sampling, documentation, and subcontractor operations to ensure that all activities are being performed in accordance with the Work Plan. The PS will report all findings to the Senior Project Engineer/Manager (SPEM).

FIGURE 20
Navy / FWENC Organization Chart



17.0 QUALITY ASSURANCE/QUALITY CONTROL

This Quality Assurance/Quality Control (QA/QC) section describes the organization, inspections, tests, procedures, and documentation necessary to produce a completed project, which complies with the governing regulations and the technical statement of work.

17.1 ORGANIZATION AND RESPONSIBILITIES

The project team will include the following personnel:

The Senior Project Engineer/Manager (SPEM) has final responsibility for the development of the Work Plan and management of the project team.

The Project Superintendent (PS) is responsible for assuring that all the work is conducted in accordance with the Work Plan. In addition, the PS is responsible for coordinating with the subcontractors for execution of all of the on-site work.

The Site Health and Safety Officer (SHSO) is responsible for the safety of all site personnel, as detailed in the site-specific Health and Safety Plan (HASP), presented under separate cover.

Foster Wheeler Environmental will direct and maintain responsibility for the overall QA/QC requirements. Subcontractors shall be used for well drilling and installation, laboratory analyses, electrical connections, and waste removal.

17.2 PROBLEM OR WORK DEFICIENCY

If a major problem or deficiency occurs or is likely to occur, a special meeting to address related issues will be held. The meeting may be attended by the SPEM, Navy Representative(s) and others, as required. Meetings may be conducted at NWS Earle, Northern Division, or by teleconference. The purpose of the meeting will be to define and resolve potential problems or work deficiencies in the following manner:

- Define and discuss the problem or deficiency
- Review alternative solutions, including their effects on schedule and budget
- Implement plan to resolve the problem or deficiency

17.3 SUBMITTALS

The Submittal List for this project is provided as Table 17-1.

The Quality Control Manager is responsible for maintaining the submittal register and reviewing and certifying that submittals are in compliance with the contract requirements.

All submittals will be accompanied by a transmittal form, which will identify the submittal and provide a unique tracking number.

17.4 CHANGES

If circumstances develop during the project that makes it necessary or advisable to revise the Work Plan in order to accomplish project objectives, a Change Request Form (CRF) will be forwarded to the Navy for approval. Events such as a change in the site conditions or system performance may result in a CRF. Changes may be discussed with the Navy Design Manager telephonically and followed up with a CRF to avoid negative impacts on the project budget. A typical CRF used to document field changes is provided as Figure 18.

17.5 DOCUMENTATION

Documentation of operations, record keeping, photographic evidence of work performed, and any engineering or analytical results will be provided to the Navy in regularly-scheduled Progress Reports for the full-scale AS/SVE system.

17.5.1 Operations Record Keeping

All field inspection and testing activities will be documented in a project logbook. The project logbook will be maintained in accordance with the relevant Foster Wheeler Environmental Field Technical Guidelines. The Project Manager will maintain records of quality control operations and activities for subcontractors and suppliers.

17.5.2 Photographic Documentation

Still 35mm color photographs will be taken as needed to record work progress. At a minimum, photographs will be taken of the existing conditions before work begins, during the construction activities, and following completion of all construction activities. Photograph location, date and description of the activity recorded will be entered in a photo documentation log.

18.0 REFERENCES

- B&R, 1997a. Proposed Plan Operable Unit 3 (OU-3) Site 26. Naval Weapons Station Earle, Colts Neck, New Jersey. Prepared by Brown and Root Environmental for Northern Division, Naval Facilities Engineering Command, December 1997.
- B&R, 1997b. Feasibility Study for Sites 4, 5, 19 & 26. Naval Weapons Station Earle, Colts Neck, New Jersey. Prepared by Brown and Root Environmental for Northern Division, Naval Facilities Engineering Command, July 1997.
- FWENC, 1998. Site 26 Close Out Report. Naval Weapons Station Earle, Colts Neck, New Jersey. Prepared by Foster Wheeler Environmental Corporation for Naval Facilities Engineering Command, July 8, 1998.
- FWENC, 1999. Air Sparging/Soil Vapor Extraction Pilot Test Report. Operable Unit No.3: Site 26, Naval Weapons Station Earle, Colts Neck, New Jersey. Prepared by Foster Wheeler Environmental Corporation for Naval Facilities Engineering Command, June 14, 1998.

APPENDIX A
LITH LOGS FROM AS/SVE PILOT TEST

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Borehole Log

 PAGE 1 OF 3
PROJECT: NWS- Earle, Site 26

BORING NO: FW-1

PROJECT LOCATION: Colts Neck, NJ

SURFACE ELEVATION:
SUBCONTRACTOR/DRILLER: CT&E

DATE STARTED: 4/28/99

FIELD GEOLOGIST: D. Walsh/C. Joblon

DATE COMPLETED: 4/28/99

DRILLING METHOD: Hollow-stem Auger

REMARKS:

Depth	Blows /6"	Recov- ery	Color	Material Description	USCS Class- ification	Remarks	Profile
0'	7	50%	Yel-brn	0-.7' Unconsol, fine sand with abundant gravel	SW	No Odor	
	9		Dk grey	.7-1' A/A less gravel, dry	SP		
	10						
	14						
2'	17	100%	Grey	2-3' Unc. fine sand A/A	SP		
	12						
	11		Yel-brn	3-4' Fine-med sand A/A	SW		
	12						
4'	4	90%	Gry- white	4-5.5' A/A with inc. gravel	SP		
	12						
	18		Yel-brn	5.5-5.9' Unc, fine-med sand	SW		
	20						
6'	21	100%		6-6.5' C sand & gravel, unc, dry	SW		
	15						
	15			6.5-7.5' F sand, unc, damp-moist	SP		
	16			7.5-8' F-C sand, damp	SW		
8'	12	75%		8-8.5' Med-C sand & fine gravel, wet		No odor	
	14			8.5-9' F sand, coarsening with depth	SP		
	15			9-9.5' F sand w/ mod silt, unc & wet	SM		
	17						

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Borehole Log

 PAGE 2 OF 3
PROJECT: NWS- Earle, Site 26
BORING NO.: FW-1
PROJECT LOCATION: Colts Neck, NJ
SURFACE ELEVATION: _____

SUBCONTRACTOR/DRILLER: CT&E
DATE STARTED: 4/28/99
FIELD GEOLOGIST: D. Walsh/C. Joblon
DATE COMPLETED: 4/28/99
DRILLING METHOD: Hollow-stem Auger
REMARKS: _____

Depth	Blows /6"	Recov- ery	Color	Material Description	USCS Class- ification	Remarks	Profile
10'	7 10 14 17	75%		10-10.8: A/A 10.8-11.5': F sand, v: unc, wet/saturated	SM-SW SP		
12'		100%	Dk yel-org yel-org & lt gry	12-13' Sat F sand w/mod silt & occ. gravel Gravel more abund. @ 12-813' 13-14' F sand	SW SP		
14'	8 10 16 13	100%	p.yel- org& lt gry	14-14.8': A/A w/ sl incr sand fines 14.8-15': F sand & silt lenses(v. thin) 15-16': Mottled, F sand	SP-SM SM SP		
16'	7 12 18 21	100%	Mostly yel-brn & some lt gry	All F sand, unc, saturated @ 17.2-17.5' Minor ilt in grey areas	SP		
18'	19 24 34 34	75%	lt grn-gry	18-18.5': F sand w/ 2" gravel zone @ 18.5' 18.5-19.5': F sand, minor fines Laminated w/ numerous heavy mineral streaks Soils are very loose (running sands) Augering is difficult w/ truck-mounted rig	SP SP		

PAGE 3 OF 3

PROJECT: NWS- Earle, Site 26

BORING NO.: FW-1

PROJECT LOCATION: Colts Neck, NJ

SURFACE ELEVATION:

SUBCONTRACTOR/DRILLER: CT&E

DATE STARTED: 4/28/99

FIELD GEOLOGIST: D. Walsh/C. Joblon

DATE COMPLETED: 4/28/99

DRILLING METHOD: Hollow-stem Auger

REMARKS:

Depth	Blows /6"	Recovery	Color	Material Description	USCS Class- ification	Remarks	Profile
20'	9 12 17 22	75%	All yel-brn	VF-F sand A/A; occ gravel frag			
22'	12 12 7 7	100%	Yel-brn & lt gry-grn yel-org	22-23.8': VF-F sand A/A 23.8-24': VF sand & silt. TD here Will set screen from 5-20' bgs			
24'							

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Borehole Log

 PAGE 1 OF 2
PROJECT: NWS- Earle, Site 26

BORING NO: FW-2

PROJECT LOCATION: Colts Neck, NJ

SURFACE ELEVATION:
SUBCONTRACTOR/DRILLER: CT&E

DATE STARTED: 4/28/99

FIELD GEOLOGIST: D. Walsh/C. Joblon

DATE COMPLETED: 4/28/99

DRILLING METHOD: Hollow-stem Auger

REMARKS: Located 20' SW of GB-1
 Augered to 5' bgs before spooning

Depth	Blows /6"	Recov- ery	Color	Material Description	USCS Class- ification	Remarks	Profile
5'	4 7 8 7	75%	yel-brn	5-6.5': F sand, unc & dry occ gravel/pebbles	SP		
7'	7 8 14 17	85%	Buff	7-8': A/A 8-8.7': F-C sand & gravel	SW	Damp	
9'	3 6 10 15	60%	P. yel-org P. yel-org	9-9.6': VF-F sand & silt 9.6-10.2': VF-F sand, little fines	SM SW-SP	Saturated, wet Saturated	
11'	9 7 8 14	75%	P. yel-org & lt gry Yel-org	11-11.3': Med sand w/ few pebbles 11.3-12.2': Fine sand	SW SP	 Saturated	
13'	7 9 12 15	100%	Yel-org & lt gry	12.2-12.5': A/A, w/ a few silty clay laminae 13-13.5': A/A 13.5-13.9': M-C sand & gravel 13.9-15': Mottled, F sand	SM-SP SP SW-GW SP	 Saturated No Odor	

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Borehole Log

 PAGE 1 OF 3
PROJECT: NWS- Earle, Site 26

BORING NO: FW-7

PROJECT LOCATION: Colts Neck, NJ

SURFACE ELEVATION:
SUBCONTRACTOR/DRILLER: CT&E

DATE STARTED: 4/29/99

FIELD GEOLOGIST: D. Walsh/C. Joblon

DATE COMPLETED: 4/29/99

DRILLING METHOD: Hollow-stem Auger

REMARKS: AS/SVEM Depth to 22'

Depth	Blows /6"	Recovery	Color	Material Description	USCS Class- ification	Remarks	Profile
0'			Grey/br	0-0.5' F sand, dry, with trace of gravel			
	6						
	6	50%	Grey/ beige	0.5-1' Laminated, F sand			
	5						
	4						
2'			Or/brn	2-2.5' F-M sand, trace silt, mottled color			
	4						
	6	75%					
	7		Lt Gry	2.5-3.5' VF-F sand w/ trace wood chip			
	7						
4'			OR	4-4.85' VF-F sand w/ trace silt			
	4						
	6	75%	Or/ Beige	4.85-5.08' F-C sand w/ some gravel			
	17						
	18		Or/ White	5.08-5.8' Inter bed, vf-f sand			
6'			Or/Dk Brn	6-6.4' F sand, laminated(g), organic materials			
	19						
	27	75%					
	14		DR/ Beige	6.4-7.2' F-C sand, w/some gravel			
	17						
			Dr/ Beige	7.2-7.5' Lam. f-m sand Core: pid-nab			
8'			Or/Dk Brn	0-4" VF-F sandw/ some silt			
	17						
	19	75%	Or/ Beige	4-18" VF-Me, interbed sand Grading to same w/ some gravel			
	20						
	20						

 Borehole: PID, PPM,
(GI-2%)
Core: 1-ppm-pid


FOSTER WHEELER ENVIRONMENTAL CORPORATION

Borehole Log

 PAGE 2 OF 3
PROJECT: NWS- Earle, Site 26
BORING NO.: FW-7
PROJECT LOCATION: Colts Neck, NJ
SURFACE ELEVATION: _____

SUBCONTRACTOR/DRILLER: CT&E
DATE STARTED: 4/29/99
FIELD GEOLOGIST: D. Walsh/C. Joblon
DATE COMPLETED: 4/29/99
DRILLING METHOD: Hollow-stem Auger
REMARKS: _____

Depth	Blows /6"	Recovery	Color	Material Description	USCS Class- ification	Remarks	Profile
10'	5	75%	Or/beige	10-10.6' VF-M, inter bed sand, some gravel		Hole: NAB	
	5			10.6-11' VF-F sand		Core: NAB	
	9		Lt gry	11-11.08' F sand, laminated, w/ white clay		Wet	
	13		Or/Lt gry	11.08-11.5' VF-F sand, interbedded			
12'	8	80%	Or	12-12.25' F-C sand, gravel, wet		Hole: NAB	
	8			12.25-13' VF-F sand w/ trace silt		Core: NAB	
	7			13-13.15' F-C sand w/ trace of gravel			
	9			13.15-13.6' VF-F sand w/ trace silt			
14'	5	85%		14-15.7' VF-F gr sand w/ trace silt, trace gravel, wet		Hole: NAB	
	5					Core: NAB	
	8						
	14						
16'	12			16-17.25' VF-F sand sand w/trace, silt, w/ trace gravel, wet		Hole: NAB	
	15					Core: NAB	
	20			17.25-18' Laminated, VF-F sand w/ trace silt			
	22						
18'	9	85%		18-19' VF-F sand w/ trace silt & gravel		Hole: NAB	
	13		Dk Or	19-19.7' VF-F sand w/ little silt		Core: NAB	
	16						
	22						

Borehole Log

PROJECT: NWS- Earle, Site 26

BORING NO: FW-7

PROJECT LOCATION: Colts Neck, NJ

SURFACE ELEVATION: _____

SUBCONTRACTOR/DRILLER: CT&E

DATE STARTED: 4/29/99

FIELD GEOLOGIST: D. Walsh/C. Joblon

DATE COMPLETED: 4/29/99

DRILLING METHOD: Hollow-stem Auger

REMARKS: _____

Depth	Blows /6"	Recovery	Color	Material Description	USCS Class- ification	Remarks	Profile
20'	7 7 14 10	90%	Dk Brn/Or/ Lt gry	20-23.9' VF-F sand, laminated		Hole: NAB Core: NAB	
22'	17 29 27 24	100%	Dk Brn/Or/ Lt Gry Dk Or	22-23.6' VF-F sand, laminated 23.6-24' VF sand w/ silt		Hole: NAB Core: NAB	
24'						Set FW-7 from 5-20'	

APPENDIX B
SAMPLING AND ANALYSIS PLAN

5.0 SAMPLE DESIGNATION

The objective of the sample identification system is to provide a framework for developing sample numbers that are unique to that sample, and convey information regarding sample type that will enable data users to easily identify sample locations. Each sample will be designated by an alpha-numeric code which will identify the site, sample location, matrix sampled, sample type, sample period, and contain a sequential sample number. For example:

26-MW04-99-01

Where:

26 – Naval Weapons Station Earle, Site 26

MW04 - Monitoring Well Number 04

MWDU - Duplicate Sample ID

99 - Sampled in 1999

01 - Sequential Number of the Sampling Round

Duplicate samples will be identified in the field logbook to indicate which sample location the duplicate represents. The location of each duplicate sample will be recorded in the field logbook by the sampling technician. The sample time on duplicate samples will be recorded as 0000 hours. Trip blank (**TB**), rinsate blank (**RB**) and equipment blank (**EB**) samples be identified by using the appropriate two-character identifier in place of **MW**.

6.0 SAMPLE SHIPPING AND CHAIN OF CUSTODY CONTROL

Samples will be packaged and shipped according to the Navy Installation Restoration Laboratory Quality Assurance Guide, February 1996, Section 4.0. Chain-of-Custody forms, sample labels, custody seals, and other sample documents will be completed as specified in the above reference manual. All entries will be made in permanent ink. If errors are made when completing any of these forms, the error will be crossed out with a single line, initialed, and dated by the sampler.

Each sample will be labeled with the following minimum information:

- Site Name;
- Sample Identification number;
- Date and time of sample collection;
- Sample preservative, if used; and
- Type of analyses to be conducted.

The samples will be packed with sufficient ice (sealed in PE bags) to cool the samples to 4°C. Enough non-combustible adsorbent cushioning material will be used to minimize the possibility of container breakage. The large PE bag in the cooler will be sealed and the container closed. Custody seals and nylon strapping tape will be affixed to the cooler. All samples will be shipped within 24 hours of collection via a common carrier. All sample coolers and samples will be shipped in accordance with NJ DOT requirements and regulations.

A Chain-of-Custody (COC) record will be used to record the custody of the samples, and will accompany the samples at all times. The following information will be contained on the COC record:

- Site name;
- Signature of samplers;
- Sample identifier, date and time of collection, grab or composite;
- Sample matrix;
- Types of analysis to be conducted; and,
- Signatures of individuals involved in the sample transfer (i.e., relinquishing and accepting the samples).

7.0 SAMPLE ANALYSES

The sample numbers, sampling matrix, sample containers/volume requirements, preservation techniques, holding time, laboratory analyses, method detection limit and field analyses requirements are presented in Table 7-1.

All laboratory analytical data will be submitted to NJDEP in an electronic format compatible with one of those specified in the Site Remediation Program Electronic Data Interchange Manual. In addition to NJDEP's HAZSITE program format, properly formatted Lotus-compatible spreadsheets and/or DBF database files are acceptable.

Table 7-1
NWS-EARLE: Site 26 AS/SVE Program
SAMPLE COLLECTION AND ANALYTICAL INFORMATION

Laboratory Analyses	No. of Samples	Sample Media	Sampling Method	Sample Containers	Sample Preservation	Rationale	Field Analyses
Field analyses via portable Gas Chromatograph for TCE, DCE, and vinyl chloride	20	Groundwater	Modified Low Flow using peristaltic pumps	40 ml VOA vials	Water bath at room temperature	Confirmation of magnitude and extent of TCE/DCE groundwater plume	TCE, DCE and vinyl chloride via portable GC
Volatile Organic Compounds (VOCs) Method 8260A (SW-846)	6 (1D) (1T) (1FB)	Groundwater	Modified Low Stress, submers. pump and bailers	Three 40 ml glass vials w/Teflon septum caps	HCL to pH <2 Cool to 4°C	Confirmation of groundwater contamination boundary via HydroPunch and existing on-site wells	pH, conductivity, temperature, ORP, DO and turbidity
Selected Inorganics (Iron, Lead, Manganese) Method 6010 (SW-846)	6 (1D) (1T) (1FB)	Groundwater	Modified Low Stress, submers. pump and bailers	1 liter poly bottle	HNO3 to pH <2 Cool to 4°C	Confirmation of groundwater contamination boundary via HydroPunch and existing on-site wells	pH, conductivity, temperature, ORP, DO and turbidity
Volatile Organic Compounds (VOCs) Method 8260A (SW-846)	24 (2D) (2T)	Groundwater	Low Flow, with dedicated pumps	Three 40 ml glass vials w/Teflon septum caps	HCL to pH <2 Cool to 4°C	Biannual groundwater sampling from monitoring wells to confirm the plume boundaries	pH, conductivity, temperature, ORP, DO and turbidity
Ignitability: SW846 Method 1020, Corrosivity: SW846 Method 1110, Reactivity: SW846, Chapter 7	1	Soil	Composite	One 8-oz jar	Ice	Soil classification for off-site transportation and disposal (soils generated during installation of vertical SVE wells)	N/A
Total Petroleum Hydrocarbons: SW846 Method 418.1	1	Soil	Composite	One 8-oz jar	Ice	Soil classification for off-site transportation and disposal	N/A
Full TCLP SW846 1311 with applicable. Methods following.	1	Soil	Composite	Two 8-oz jars	Ice	Soil classification for off-site transportation and disposal	N/A
TOX: SW846 Method 3540A/9020A	1	Soil	Composite	One 4-oz jar	Ice	Soil classification for off-site transportation and disposal	N/A
TAL metals-EPA SW846	2	Soil	Composite	One 8-oz jar	Ice	Soil classification for off-site transportation and disposal	N/A

Notes: The number in parentheses in the "No. of Samples" column denotes the number of samples from the total that are duplicates (D) and Trip (T).

MASTER-FLO™

Bladder Pumps

5600 Series

USER'S GUIDE

User's Guide

MASTER-FLO™ Bladder Pumps 5600 Series

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Initial Inspection

MASTER-FLO 5600 Series Bladder Pumps are designed primarily for PORTABLE ground water sampling use, with threaded connections enabling easy in-field assembly/disassembly without the need for tools. Dedicated installations can also be supported by calling GEOGUARD for assistance.

A number of pump models are available in the 5600 Series with pump body diameters of 1.38" (35 mm), 1.66" (42 mm), 1.75" (45 mm), and 1.90" (48 mm). Pumps are also available in a choice of three EPA recommended materials: 316 Stainless Steel and Teflon®, PVC and Teflon®, and all Teflon®.

Open the shipping container and remove the contents.

The pump that was ordered should be contained in an individual polyethylene bag, with a contaminant-free certification tag. If the pump is damaged, or the tag is missing, contact GEOGUARD at 1-800-645-7654 right away.

User Safety Warning

Compressed air can be dangerous.

- ✓ Use caution when operating pneumatic equipment. Keep eyes clear of the quick exhaust valve when the controller is in the refill mode.
- ✓ In the event of an airline rupture, turn off the air supply (compressor or gas cylinder) immediately.
- ✓ If using a bottled gas supply, follow local regulations. Always use a two-stage regulator on the tank.

Model 5001 and 55000 Cycle Controllers are designed to be used with oil-less, instrument grade air as supplied by GEOGUARD compressor assemblies. The air inlet filter supplied with the controller is designed to remove water and airborne particles only. It is NOT designed to remove oil from the air supply. Supplying less than instrument grade air, therefore, may damage the controller and void the controller warranty.

NOTE:

If you have any questions about the safe operation of this equipment, call 1-800-645-7654 for assistance.

Using This Guide

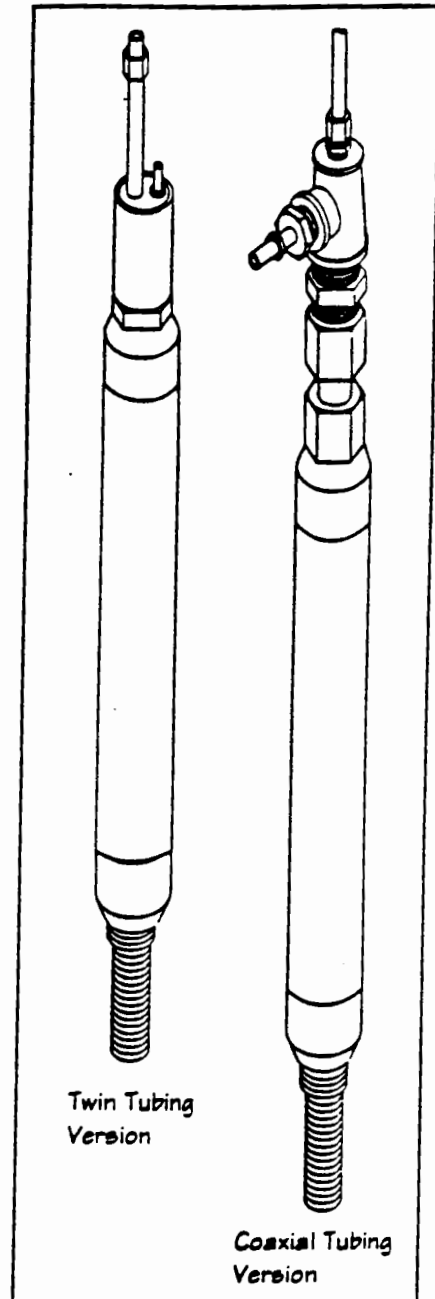
This guide is divided into two sections:

- 1. The first section provides an overview of the 5600 Series Bladder Pump, covering its principle of operation, detailing the procedure for assembly/disassembly, and showing the pump's relation to a basic, portable, ground water sampling system.**
- 2. The second section provides the specific setup, operating, and shut down instructions for use of the 5600 Series Bladder Pump with the 5001 or 55000 Cycle Controllers.**

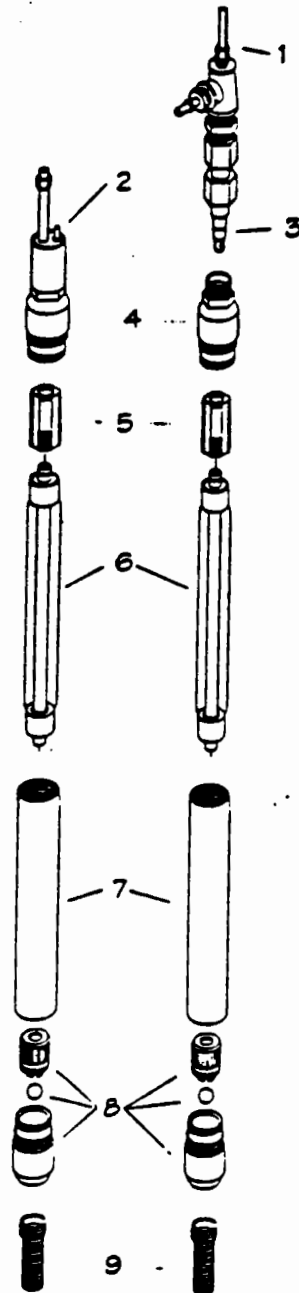
Section L...Overview

Description: MASTER-FLO 5600 Series Bladder Pumps are designed primarily for portable ground water sampling use. Threaded connections enable easy in-field assembly/disassembly, facilitating bladder cartridge replacement, without the need for tools. A number of models are available in this series with pump body diameters measuring 1.38" (35 mm), 1.66" (42 mm), 1.75" (45 mm), and 1.90" (48 mm). The smallest diameter pump will fit a 1.5 inch, or restricted, well casing. The shortest length can be flexibly linked to another to allow for bent casings. All models can be lengthened for improved flow rate and longer periods of low, continuous flow.

Pumps are available in three EPA recommended materials: 316 Stainless Steel and Teflon®, PVC and Teflon®, and all Teflon®. All pumps feature large (.375") water discharge porting to reduce the pressure gradient between the bladder and discharge tubing, lessening the potential for orifice outgassing that can compromise dissolved gas and VOC samples.



Assembly/Disassembly of 5600 Series Bladder Pumps



Note: Both the Twin Tubing and Coaxial Versions are shown.

- 1) Coaxial Splitter
- 2) Twin Top
- 3) Barbed Fitting
- 4) Top Fitting
- 5) Upper Check Valve Assembly
- 6) Bladder Cartridge
- 7) Pump Body
- 8) Lower Check Valve Assembly
- 9) Intake Screen (Optional)

Useful Tip

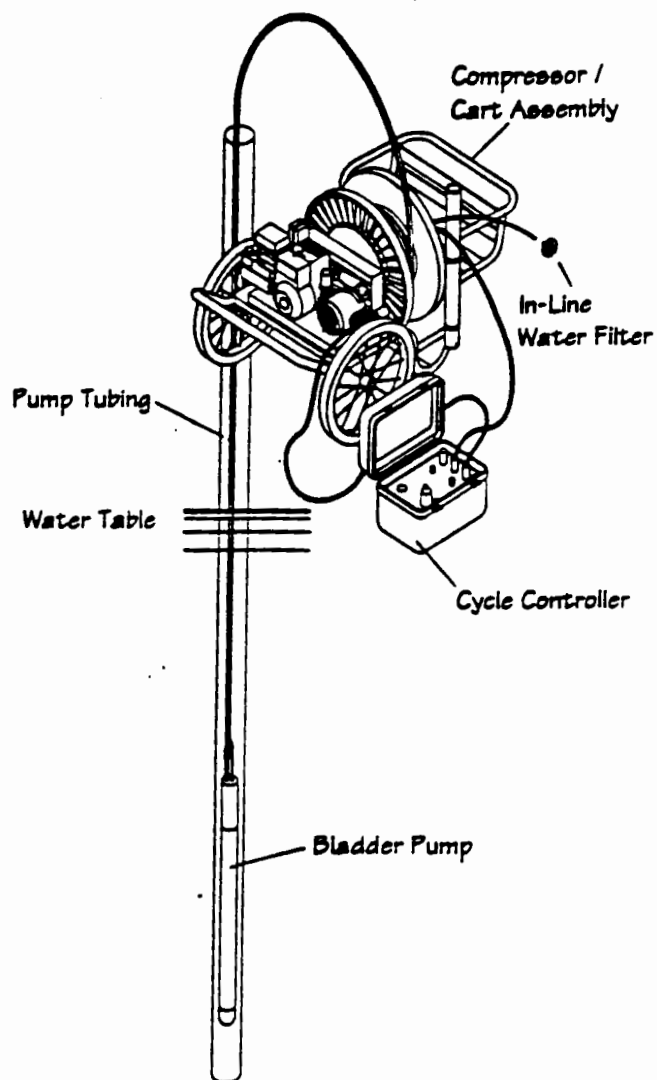
To prevent threads from locking up with sand and silt, put a couple of wraps of Teflon tape around male threads before assembling.

Bladder Pump Operating Principle

MASTER-FLO 5600 Series Bladder Pumps consist of an upper check valve assembly, a bladder cartridge, a lower check valve assembly, and a rigid pump body. When assembled, the bladder cartridge is connected between the upper and lower check valve assemblies. The upper check valve prevents water in the pump's water discharge line from re-entering the pump body during its air vent (water refill) cycle. Both drive air and water discharge lines attach at the top of the pump. When the pump is completely submerged, hydrostatic pressure opens the lower check valve allowing water from the well to enter the bladder. Compressed air is then applied through the drive air tubing attached to the upper check valve assembly. The drive air is delivered to the annular space between the outer surface of the bladder cartridge and the inner wall of the pump housing. The air pressure squeezes the bladder, causing the lower check valve to close, driving water out of the bladder cartridge, past the upper check valve, and into the sample discharge line. When the bladder is empty, drive air is cut off by the cycle controller, and, as air is vented from the pump body through the drive air line, the hydrostatic pressure of the water column forces water into the bladder, past the bottom check valve, starting the refill process over again.

The Basic, Portable, Ground Water Sampling System

Static Water
Level Indicator



Section II...5600 Series Bladder Pump System Operating Instructions

IMPORTANT NOTE:

The following system operating instructions for the 5600 Series Bladder Pump assumes that you are using either a GEOGUARD Model 5001 Electric Cycle Controller or Model 55000 Digital Cycle Controller to operate your system.

If you are using a different controller, the operating instructions provided here may be similar, however you should refer to the User's Guide that came with YOUR controller BEFORE attempting to operate your system.

Basic Equipment Required For System Operation

Oil-less Air Compressor - GEOGUARD Model 5404 compressor assembly, or similar, Oil-less, compressed air source.

Portable Tubing Reel - Including drive air nipple for attachment of drive air line from controller. The reel is an integral part of the GEOGUARD Model 5401 compressor assembly, mounted on a cart with detachable, 20 inch, semi-pneumatic wheels.

Pump Tubing - Bonded twin, as specified in the Tubing Options chart at the end of this Guide.

Cycle Controller - such as Models 5001 or 55000 covered here.

Model 5001 Controller Setup and Operation

Battery

Connect the 12 Volt DC battery to the controller.

Note:

A new, fully charged battery will offer up to 40 hours of service. When the battery has been 90% drained, a 16 hour recharge is required. By periodically charging the battery after a day or two of use, an overnight charge will generally be sufficient. The charger supplied is a constant voltage, limited current type that will not cause the battery to be overcharged. (Use the charger INDOORS as it is ungrounded.)

Air Hose Attachment

Install the male end of the 10 foot air line(s) into the controller's female quick connect fitting(s). Single pump systems are always connected to "Pump One." In a dual pump system, the deepest pump in the well will be connected to "Pump One," and the shallower pump to "Pump Two." Install the female end of the 10 foot air line(s) over the male quick connect fitting(s) on the portable hose reel.

Install the in-line air filter onto the controller's "Air Inlet" fitting.

Install the 25 foot air line (with a female connector on each end) between the air filter on the controller and the drive air source...typically a GEOGUARD Portable, Oil-less Compressor.

Initial Settings

Set the controller "Pressure Time" knob at the 10 o'clock position. This setting corresponds to approximately 13 seconds pump time.

Set the controller "Exhaust Time" knob at the 9 o'clock position. This setting corresponds to approximately 7 seconds fill time.

Turn on the drive air source (compressor).

Rotate the "Flow Control" knob on the controller in a clockwise direction, until the "Output Pressure" gauge reads approximately one psi for each two feet of lift in the well. (For example, 100 feet of lift would read 50 psi on the controller gauge.)

Turn on the controller.

Setting Pressure Time (Discharge Mode)

Let the controller go through a number of cycles to fill the pump discharge tubing. The time required to fill the tubing will vary with pump configuration, depth and submergence.

When water begins to flow from the discharge tubing, observe the flow in relation to the "Pressure Time" knob setting. One of two conditions will occur:

1. If the controller switches to the exhaust mode (and you hear a hiss) before the water stops flowing from the discharge tube...increase pressure time by rotating the controller "Pressure Time" knob clockwise. Allow the controller to make one complete cycle...continuing to rotate

the knob clockwise, then waiting for a complete cycle, and again rotating the knob clockwise until the controller switches to exhaust, just as the water stops flowing from the discharge tube.

2. If water stops flowing from the discharge tube before the controller switches to exhaust, then decrease pressure time by rotating the "Pressure Time" knob counterclockwise. Again...allow the controller to make one complete cycle, continuing to adjust the knob and allowing complete cycles between adjustments, until the controller switches to exhaust just as water stops flowing from the discharge tube.

Setting Exhaust Time (Refill Mode)

The "Exhaust Time" knob adjustment will be very similar to the "Pressure Time" knob adjustment...with this adjustment being used to vent the pump of air while it fills with water.

Turn the "Exhaust Time" knob counter clockwise from its original 9 o'clock setting to 8 o'clock, observing the quantity of water discharged per cycle. Continue turning the knob counterclockwise until a reduction in the quantity of water discharged per cycle occurs.

Now increase exhaust time, by turning the knob clockwise, and continue to turn the knob clockwise until there is no increase in discharged water volume. Hold the setting at this point, as this is the maximum fill point of the pump.

Adjusting Flow Control

The final running adjustment will be the setting of the "Flow Control" knob, used to control the drive air pressure to the downwell pump or pumps.

Refill Timing

To obtain optimum performance from a bladder pump it is necessary to adjust the refill time such that the controller switches to the discharge segment of the cycle at the exact time the pump is refilled to capacity. The discharge segment of the cycle described above provides the benchmark for setting the refill segment. The refill time must be adjusted such that the discharge pulse does not decrease in volume.

In the preceding section the initial refill time was set at 15 seconds to assure that the pump would be filled to capacity during the setting of the discharge time. Setting the refill time requires reducing the time setting to match the exact time needed to completely refill the pump.

Setting the Refill Time for a Bladder Pump

Decrease the refill time setting by 1 second increments. Allow the pump to complete one full cycle between adjustments.

Observe the water exiting the discharge tubing.

When water stops discharging before the controller switches to the refill segment of the cycle, it means that the refill time has been reduced too much.

Gradually increase the refill time by .1 second increments until the controller switches to the refill segment at the exact time water stops discharging from the pump.

Using *Pressure Adjust* to Decrease Flow Rate

It is often advantageous to maximize pump flow rate for purging or well development, however, it is sometimes necessary to reduce the flow rate. Examples include reducing flow rate from a bladder pump during the collection of volatile organic compounds, or for matching the recovery rate of a well during purging. Reducing the flow rate requires the use of the *Pressure Adjust* knob on the controller panel.

Adjusting the Flow Rate from a Bladder Pump

Turn the controller off by pressing the *Power* button on the controller panel (*the LCD window will go blank*).

Disconnect the *Air Out* hose from the controller panel.

Re-start the controller by pressing the *Power* button.

Observe the pressure gauge on the controller panel (*the gauge will only register a pressure reading during the discharge segment of the cycle*).

Rotate the *Pressure Adjust* knob on the controller panel counterclockwise until the pressure, in psi, shown on the panel mounted gauge is approximately one half the lift in feet (*example: 125 feet of lift, the pressure gauge should register approximately 62 psi*).

Reconnect the *Air Out* hose to the controller.

Increase the discharge time to compensate for the decrease in air displacement to fully evacuate the contents of the bladder.

Observing the water exiting the pump discharge tubing, slightly increase or decrease the pressure using the *Pressure Adjust* knob to obtain the desired flow rate.

System Shutdown

When you're done collecting samples...

Turn off the compressor.

Turn off the controller.

Pull the quick connect fitting(s) at the controller **FIRST** to disconnect the Air Out line(s). Disconnect the air line at the hose reel **SECOND**. (*The reason for this procedure is to avoid blowing out an internal gasket on the end of the air line with the quick exhaust valve.*)

Pull the quick connect fitting at the controller to disconnect the Air In line from the compressor.

Remove the air filter from the controller (if so equipped).

Pack up all components neatly and gather samples.

Secure locking cover over the well head if so equipped.

Move on to the next site.

Appendix 1

Tubing Options

Tubing Options The 5600 Series Bladder Pump is designed for use with bonded twin tubing. Twin tubing is configured with the water discharge tube thermally bonded adjacent to the air tubing. This style is very easy to lengthen and shorten.				
Model #	Style	Material	Air Tube I.D.xO.D. in./cm.	Water Tube I.D.xO.D. in./cm.
5916	Bonded Twin	Pure Teflon	.250 x .375 0.63 x 0.95	.375 x .500 0.95 x 1.27
5896	Bonded Twin	Polyethylene	.250 x .375 0.63 x 0.95	.375 x .500 0.95 x 1.27
5897	Bonded Twin	Teflon lined Polyethylene	.250 x .375 0.63 x 0.95	.375 x .500 0.95 x 1.27
5073	Coaxial	Teflon lined Polyethylene discharge	.625 x .750 1.59 x 1.91	.375 x .500 0.95 x 1.27
5090	Coaxial	Polyethylene	.625 x .750 1.59 x 1.91	.375 x .500 0.95 x 1.27

Appendix 2
Bladder Pump Capacities

Bladder Pump Capacities					
Model	Tubing	Material	Diameter in./mm.	Length in./cm.	Capacity
5605	Twin	S.S./Teflon	1.38/35	43/109	400 ml.
5609	Twin	S.S./Teflon	1.38/35	30/76	225 ml.
5615	Twin	S.S./Teflon	1.66/42	43/109	550 ml.
5625	Twin	PVC/Teflon	1.66/42	43/109	400 ml.
5635	Twin	PVC/Teflon	1.90/48	43/109	550 ml.
5645	Twin	Teflon	1.75/45	43/109	400 ml.
5603	Coaxial	S.S./Teflon	1.38/35	43/109	400ml.
5613	Coaxial	S.S./Teflon	1.66/42	43/109	550ml.
5623	Coaxial	PVC/Teflon	1.66/42	43/109	400ml.
5633	Coaxial	PVC/Teflon	1.90/48	43/109	550ml.
5643	Coaxial	Teflon	1.75/45	43/109	400ml.

Appendix 3 Replacement Parts

Item	Pump Model Number					
Description	5609 ^T	5603 ^C 5605 ^T	5613 ^C 5615 ^T	5623 ^C 5625 ^T	5633 ^C 5635 ^T	5643 ^C 5645 ^T
Lower check valve assembly	5344	5344	5253	5343	5189	5196
Bladder assembly	5574	5571	5570	5571	5570	5571
Pump body	5547	5487	5847	5488	5544	5524
Upper check valve assembly	5557	5557	5557	5557	5557	5557
Barbed fitting	5489	5489	5489	5489	5489	5489
Top fitting	N/A 50497 ^T	5219 ^C 50497 ^T	5578 ^C 50495 ^T	5155 ^C 5983 ^T	5179 ^C 5978 ^T	5525 ^C 5979 ^T
Coaxial splitter	N/A	5585	5585	5585	5585	5585
Screened intake	5064	5064	5064	5064	5064	5064

C = Coaxial Models

T = Twin Tubing Models

MASTER-FLO™
Fully Pneumatic Cycle Controller
Model 5940

USER'S GUIDE

MASTER-FLAD

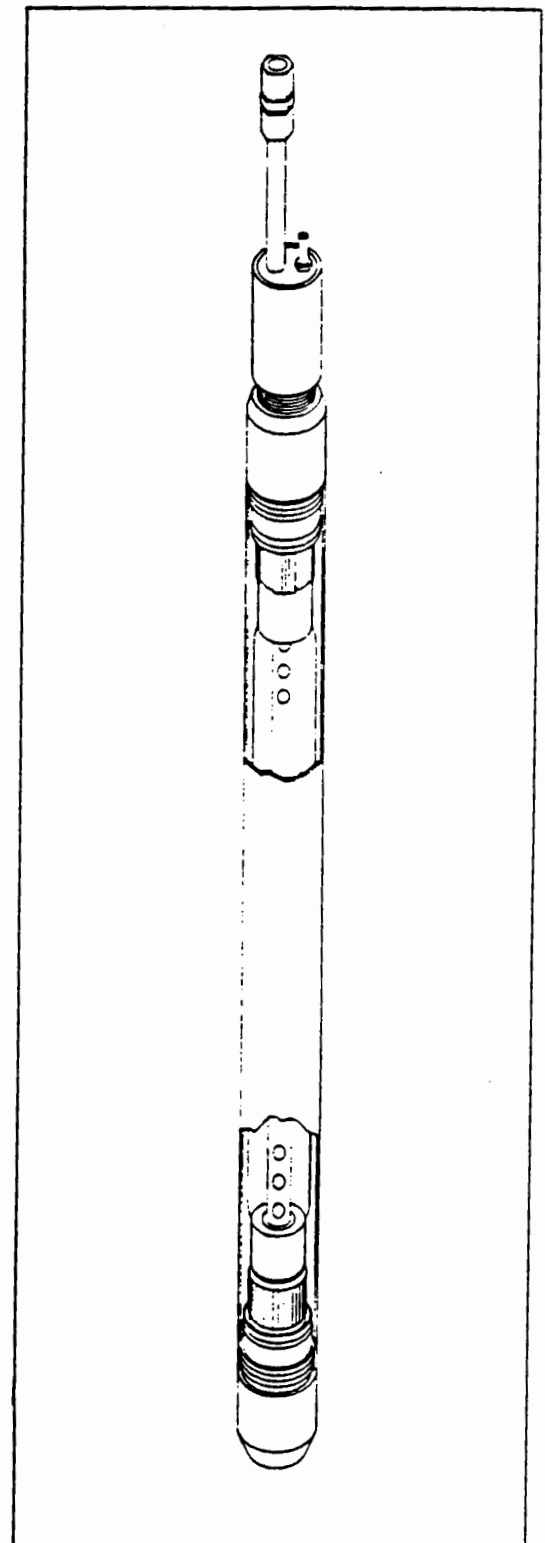
Ground Water Sampling Systems

5600 SERIES BLADDER PUMPS

Available in a wide range of sizes and capacities to meet virtually any pumping situation, GEOGUARD 5600 Series Bladder Pumps meet all EPA requirements for representative ground water monitoring in both portable and dedicated situations.

The smallest diameter pump will fit a 1.5 inch, or restricted, well casing. All models can be lengthened for improved flow rate and longer periods of low, continuous flow.

- Available in pump diameters for 1.5" (38.1 mm) and larger wells.
- Pumping rates up to 2.5 gpm (9.5 lpm) @ 25 ft. (7.62 m) in a 2" (51 mm) well...large air and water porting enables faster pump/fill cycles; larger bladder than conventional bladder pumps permits more volume pumped per cycle.
- EPA recommended materials including Type 316 Stainless Steel and Teflon®, PVC and Teflon®, or all Teflon®.
- Large water discharge porting (.375 inch) reduces pressure gradients between the bladder and discharge tubing, lessening the potential for orifice outgassing that can compromise dissolved gas and VOC samples.
- Factory sealed, field replaceable, Teflon® bladder cartridges slip into place, without tools or clamps. Lifetime guarantee on all dedicated components.
- Withstands dry pumping.
- Threaded pump intakes permit the use of intake drop tube extensions, booster pump applications, and other unique configurations.
- Type 316 Stainless Steel, .010 inch intake screens help protect bladders from sand.
- Contaminant-free certification - all pumps are cleaned, lab tested and individually sealed in polyethylene bags.



For applications assistance call 1-800-645-7654.

User's Guide

MASTER-FLO™ Pneumatic Cycle Controller Model 5940

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1-716-798-5597
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Initial Inspection

The MASTER-FLO Model 5940 Pneumatic Cycle Controller has been designed to be used portably to operate portable or dedicated ground water sampling/purging equipment. It is light weight, enabling easy in-field use without the need for tools. It can operate off of any type of compressed air source, whether it is a compressed gas cylinder or air compressor.

Open receipt of the equipment open the shipping container and remove the contents. The controller should be equipped with an air filter, one ten foot long airline assembly, and one twenty five foot long airline assembly. If the controller is damaged, or any of the contents are missing, contact GEOGUARD at 1-800-645-7654 right away.

User Safety Warning

Compressed air can be dangerous.

- ✓ Use caution when operating pneumatic equipment. Keep eyes clear of the quick exhaust valve when the controller is in the refill mode.
- ✓ In the event of an airline rupture, turn off the air supply (compressor or gas cylinder) immediately.
- ✓ If using a bottled gas supply, follow local regulations. Always use a two-stage regulator on the tank.

The Model 5940 Cycle Controller has been designed to be used with oil-less, instrument grade air as supplied by GEOGUARD compressor assemblies. The inlet air filter supplied with the controller is designed to remove water and airborne particles only. It s NOT designed to remove oil from the air supply. Supplying less than instrument grade air, therefore, may damage the controller and void the controller warranty.

NOTE

If you have any questions about
the safe operation of this equipment, call
1-800-645-7654 for assistance.

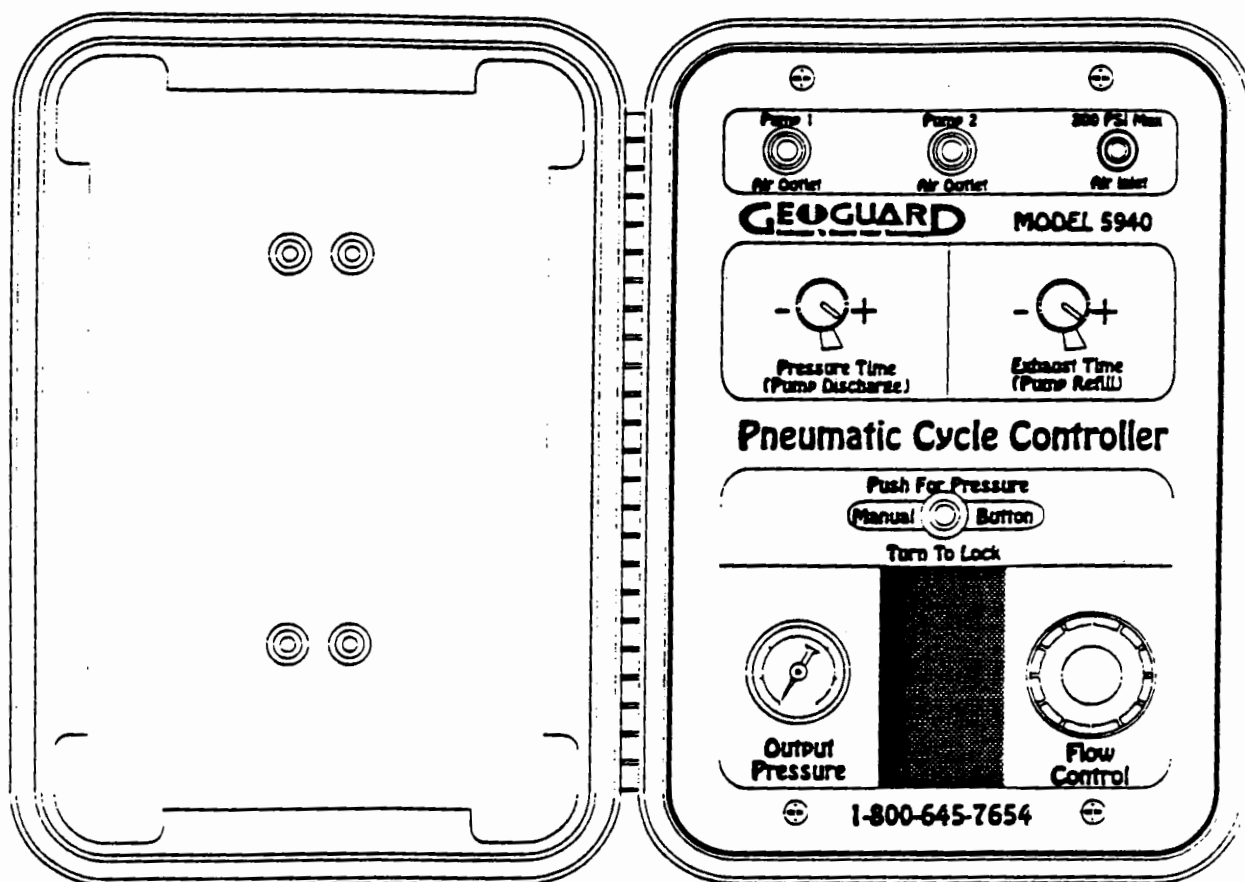


Figure 1 5940 Controller

Introduction

The Model 5940 Fully Pneumatic Cycle Controller is an automatic compressed air regulator. It operates without batteries or other electrical power, making it intrinsically safe for use in hazardous locations.

The unit is housed in a rugged, light weight molded polyethylene carrying case, and is supplied with the following accessories:

- * Inlet 5 micron air filter assembly. Assures that the controller receives clean, dry compressed air. Quick connects onto the front panel of the controller.
- * 25 foot long industrial airline with quick connect fittings for attachment to the inlet air filter and to the compressed air supply.
- * 10 foot long industrial airline with quick exhaust valve and quick connect fittings for attachment from the controller panel to the pump.

The controller has the following panel mounted features:

- * Independent pump discharge and refill timers. The timers are adjustable from 1 second up to 3 minutes (1 minute on the discharge cycle) to permit optimum adjustment of the pump (gas-drive or bladder) over a complete range of lift and submergence conditions.
- * 0 to 300 psi liquid filled pressure gauge. The gauge indicates the drive air pressure being delivered to the pump. The internal liquid prevents damage due to shock or vibration.
- * Flow control regulator. The regulator allows the drive air pressure to be increased or decreased, by turning the knob clockwise, or counterclockwise, respectively. Varying the drive air pressure will allow the pump to perform high rate purging, or collect samples at a rate as low as 100 ml/minute.

Start-Up

Before operating the controller, first install the pumping device to the appropriate horizon in the well, if it is a portable application. If the controller will be used to operate a dedicated pump, remove the lockable protective enclosure and attach the water discharge tube extension to the fitting on the well closure. If using a bottled gas supply, install a two-stage regulator on the tank, and make sure that the incoming supply pressure does not exceed 200 psi.

- 1) Connect one end of the 10 foot long airline with quick exhaust valve to the controller fitting labeled "Pump 1". The end of the assembly with the quick exhaust valve attaches to the well closure (for dedicated systems) or to the pump tubing (for portable systems).
- 2) Connect the air filter to the fitting labeled "Air Inlet" on the controller panel.
- 3) Connect one end of the 25 foot long airline to the inlet air filter. The opposite end of the assembly attaches to the air supply.
- 4) Turn on the air supply.

There is no on/off switch for the controller. It will automatically begin to operate once it is supplied with compressed air. The discharge and refill timers, and flow control regulator can now be adjusted to efficiently control the operation of the pump (gas-drive or bladder).

Operational Tip

When using a GEOGUARD engine driven compressor as the air source, don't connect the 25 foot long airline to the compressor until the motor has been started. The compressor will start easier without a load attached to it.

Airline Attachment

Two compressed airlines are supplied with the Model 5940 Cycle Controller. One has a large female quick connect fitting at both ends and measures 25 feet long. This airline supplies the compressed air from the source (compressor or gas bottle) to the cycle controller. If the need arises to order this as a spare part or for replacement purposes, specify P/N 5008.

The second airline has a quick exhaust valve and measures 10 feet long. This airline connects between the cycle controller and the pump. The end with the quick exhaust valve has a female quick connect fitting to attach to the well closure (for dedicated pumping systems) or to the pump tubing (or tubing reel for portable pumping systems). The opposite end of the airline has a male nipple which attaches to the fitting on the controller panel labeled "Pump 1". Specify P/N 50090 to order an additional airline.

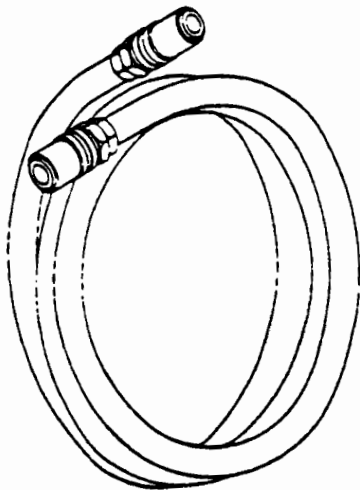


Figure 2 5008 Airline

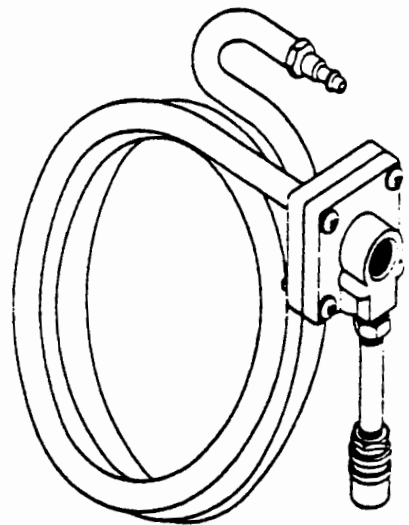


Figure 3 50090 Airline

Timing Control

The pump discharge and refill timing knobs can each be independently adjusted. The range of the timers allow them to be adjusted to optimally control virtually any pump model when used in any lift or submergence condition. When set with the knobs positioned at 6 o'clock, each will cycle at approximately a 1 second timing interval. Turning the knob clockwise will increase the time setting. Rotating the knob clockwise one full revolution will reset the timing back to 1 second when again positioned at 6 o'clock.

Note: Each timer has a "dead zone" which is located between 4 o'clock and 6 o'clock. When the knobs are set in this area the timers will lock up. This zone is indicated on the controller panel by a shaded area.

The following table lists the values of the discharge and refill timers based on the position of the knob. It is to be used for reference only.

Knob Position	Discharge Time	Refill Time
6 o'clock	1 second	1 second
9 o'clock	10 seconds	20 seconds
12 o'clock	20 seconds	45 seconds
3 o'clock	60 seconds	3 minutes

Upon initial start-up, set the discharge and refill timers to operate at a cycle rate of 10 seconds each. (Deep applications may require more discharge time.) Allow the pump to go through 5 to 6 complete cycles to fill the water discharge tubing. (Shallow applications may require fewer cycles.) When water begins to discharge from the tubing, the timers can then be adjusted to achieve optimum performance.

Discharge Time Adjustment

As water is discharging from the tubing, watch the flow of water in relation to the discharge time as set on the controller. One of the following will occur:

A) If the controller switches to the refill mode (recognizable by the hiss of escaping air from the quick exhaust valve) before water stops flowing from the discharge tube, **increase** the time setting by rotating the knob very slightly to the right (clockwise). Allow the controller to go through 1 or 2 complete cycles. Continue to increase the time (allowing at least 1 complete cycle between adjustments) until the controller switches to the refill cycle just as water stops flowing from the discharge tube.

B) If water stops flowing from the discharge tube before the controller switches to refill, **decrease** the time setting by rotating the knob slightly to the left (counterclockwise). Again, allow the controller to go through 1 or 2 complete cycles. Continue to decrease the time (allowing at least 1 complete cycle between adjustments) until the controller switches to the refill mode just as water stops flowing from the discharge tube.

Refill Time Adjustment

The refill time adjustment is very similar to the procedure used to adjust the discharge time. However, this cycle controls the amount of time allowed for the pump to vent the compressed air which was cycled to the pump during the discharge cycle. The compressed air must vent back to atmosphere to allow the pump to completely refill.

Adjustment of the refill time should occur after the discharge time has been optimized. It is possible to determine when the optimum refill time value is achieved by first adjusting the discharge timer as previously explained. For maximum pump performance, the refill time value should be minimized without causing a reduction in the quantity of water discharged per cycle.

If the refill time is shortened to the point that the pump is not completely full, then the water will stop discharging from the tubing before the controller switches from the discharge mode to the refill mode. If this occurs, *increase* the refill time by rotating the knob slightly to the right (clockwise).

Note: In a draw down situation (where the height of the water column is decreasing), more refill time may be required to allow the pump to fill completely. *If possible, monitor the volumetric output of the discharge cycle.*

Flow Control Adjustment

The large knob on the lower right corner of the controller panel labeled "Flow Control" is used to adjust the air pressure which is delivered to the pump during the discharge cycle. The initial setting of one psi for every two feet of lift will be sufficient to develop flow for most pumping applications. For maximum flow, you can rotate the "Flow Control" knob fully clockwise and then readjust the timing values as previously outlined.

Note: An increase in pump discharge pressure will typically require a reduction in "Discharge Time" and an increase in "Refill Time". Such a maximum flow rate might be desired during purging, for example. When sampling for sensitive parameters, where sample agitation or aeration must be avoided, or when pumping through a flow cell or in-line water filters, the flow from the pump may be decreased by turning the Flow Control knob counter clockwise.

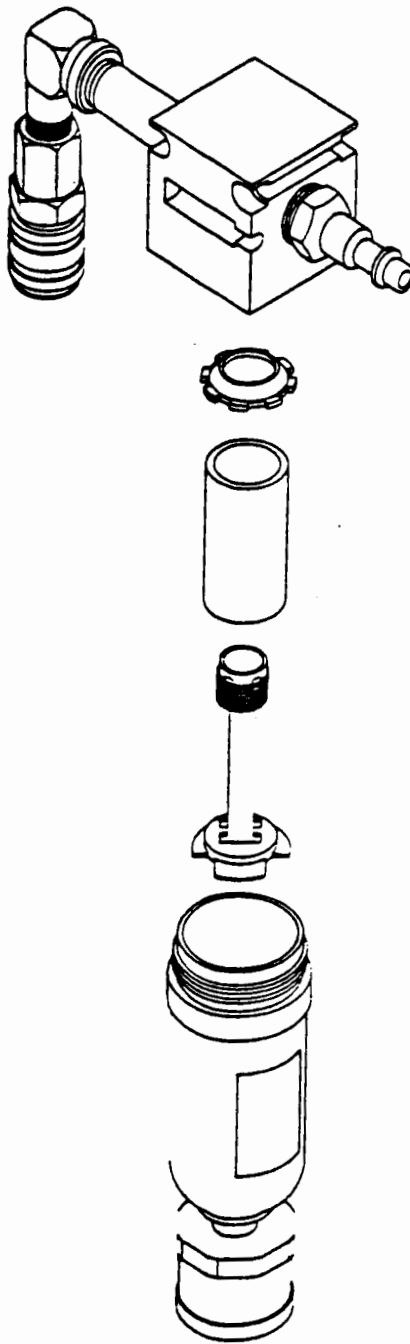


Figure 4 Air Filter Assembly

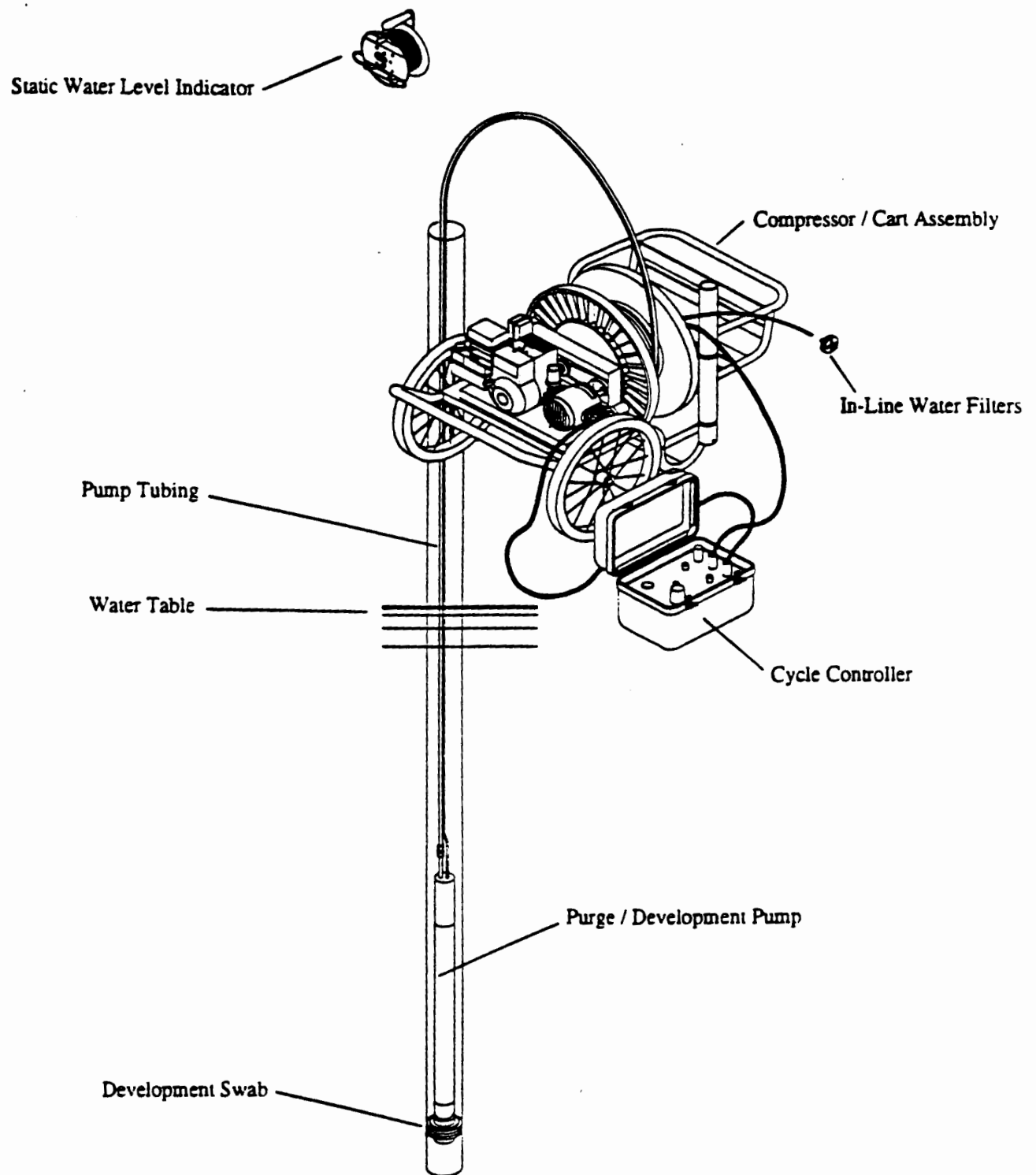


Figure 5 Basic Portable System

April 24, 1996

Foster & Wheeler Engineers
1 Oxford Valley, Suite 200
Langhorne, PA 19047

Attn: Dan Walsh

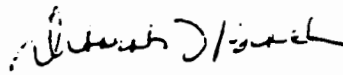
Dear Mr. Walsh:

Thank you for your call regarding the Master-Flo equipment currently in use at the Naval Weapons Station at Colts Neck, New Jersey. Our files show that ninety-nine (99) Model 5625 bladder pumps, with inlet screens, are installed at that site. I have enclosed user's manuals for the 5625, as well as for the cycle controller and compressor assembly supplied with the pumps.

A catalog which describes the complete Master-Flo line of ground water sampling equipment is also provided for your reference. If you have questions, please feel free to contact me or Paul Fox of our Customer Service Department.

Sincerely,

GEOGUARD, Inc.


Deborah L. Beach
Sales Manager

Encls/

cc: Area Representative

Martin Technologies
8 Roosevelt Way
Avondale, PA 19311
610-268-2002
Tom Chadwick

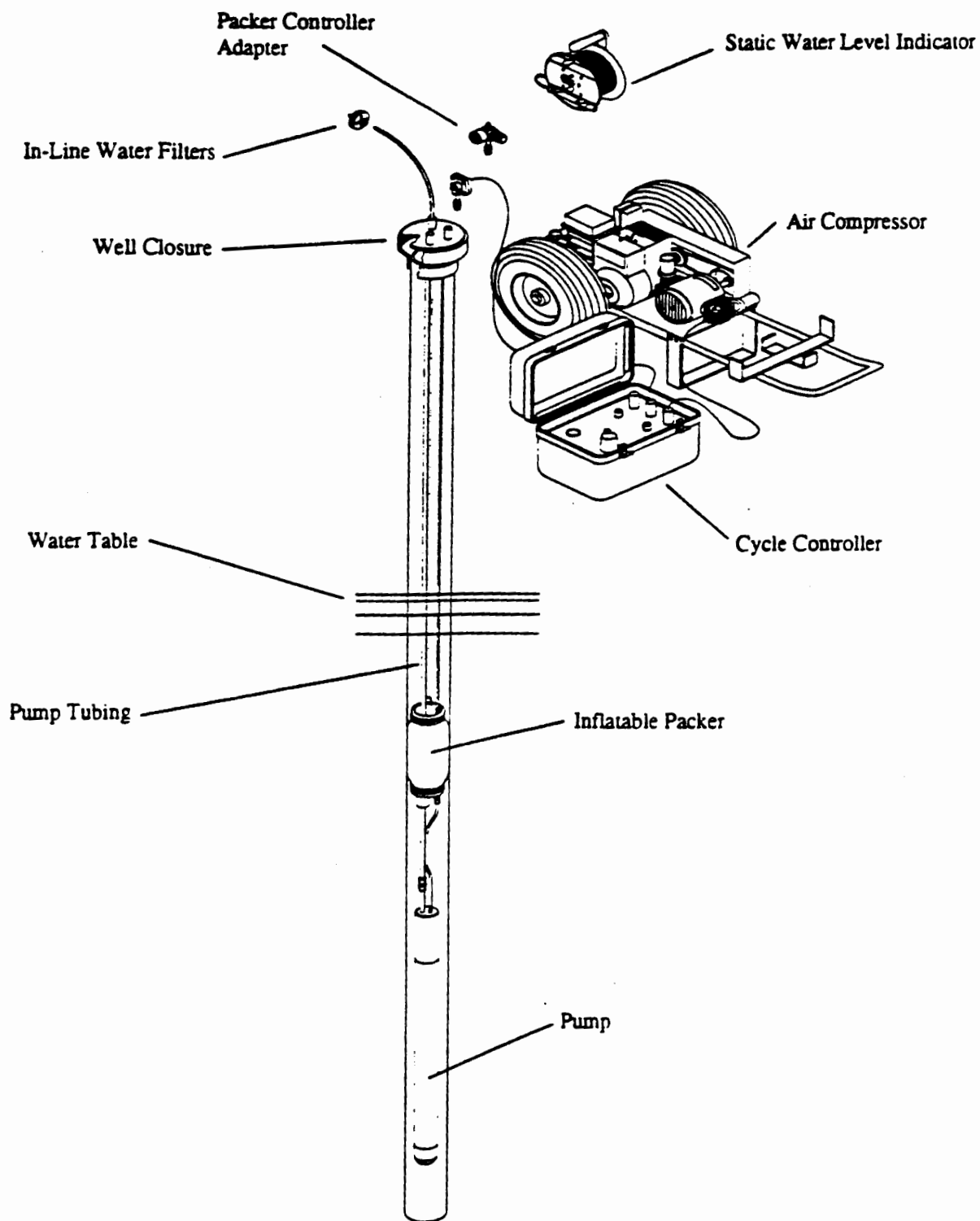


Figure 6 Basic Dedicated System

MASTER-FLO™
Engine Driven Compressors
5400 Series

USER'S GUIDE

User's Guide

MASTER-FLO™ Engine Driven Compressors 5400 Series

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Initial Inspection

MASTER-FLO engine driven compressors have been designed to be used portably to operate portable or dedicated ground water sampling/purging equipment.

Open receipt of the equipment open the shipping container and remove the contents. If the compressor is damaged, or any of the contents are missing, please contact GEOGUARD at 1-800-645-7654 right away.

User Safety Warning

Compressed air can be dangerous...

- ✓ Use caution when operating pneumatic equipment. Keep eyes clear of the quick exhaust valve if using the compressor with a pump cycle controller.
- ✓ In the event of an airline rupture, turn off the motor immediately.
- ✓ Never operate the machine without the belt guard in place.
- ✓ Allow a hot engine to cool for 5 to 10 minutes before refueling.
- ✓ Periodically check the drive belt for wear and proper alignment.

GEOGUARD compressor assemblies provide the pumping equipment with oil-less, instrument grade air. Never oil the compressor pump.

NOTE

If you have any questions about
the safe operation of this equipment, call
1-800-645-7654 for assistance.

Introduction

GEOGUARD gasoline operated engine driven compressor assemblies are available in three configurations, with a choice of either a Briggs & Stratton motor (3.5 HP) or a Honda motor (4.0 HP), as noted below.

Configuration	Briggs Motor Model	Honda Motor Model
Platform	5404	5404H
With Wheels	5420	5420H
With Cart	5401	5401H

All models utilize the same oil-less compressor pump. The compressor pump is belt driven by either the Briggs or Honda gasoline motor. The compressor is a reciprocating, dual piston type, with Teflon® piston rings and stainless steel valves for years of dependable service. The unit never requires lubrication and does not deliver oil mist in the air stream. It is designed for continuous operation, and will provide air pressure of 125 psi at a displacement rate of 3.5 SCFM.

The unit is shipped without oil in the crankcase or gasoline in the fuel tank. SAE 30 weight oil (or 10W-30) and unleaded gasoline with an octane rating of 87 or higher is recommended. When the fuel tank is completely full it will provide a minimum of 2 hours of operation. Included with this guide is pertinent owners information from the manufacturer of the motor (Briggs or Honda). Please refer to this pamphlet for specific information not included in this guide.

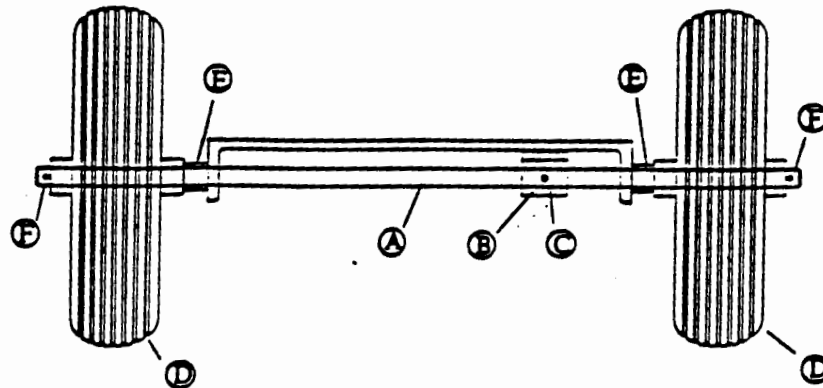
Maintenance Notes

To achieve long term dependable service the unit should be maintained regularly according to the schedule provided by Briggs or Honda. Regularly check that the crankcase is filled with oil. This is the most important thing to check. While the Honda motor has a low oil monitor which will shut down the motor when the crankcase is low, the Briggs motor does not. The easiest way to have the motor to seize is to operate it without oil.

Assembly Notes

GEOGUARD compressors are typically are shipped fully assembled, ready for immediate use. Because the compressor is bulky it is common for it to be shipped by a trucking company. When shipped via truck it is fastened to a pallet. However, on occasion, the Model 5420 unit can be shipped via UPS, and the wheels and handle must be assembled onto the platform frame. Please refer to the following drawing for this assembly detail.

Wheel/Axle Assembly Drawing For Models 5420/5420H



Item	Quantity	Description	Part Number
A	1	Axle	5739 (Briggs) 51079 (Honda)
B	1	Spacer Block	5967
C	1	Hitch Pin	5411
D	2	16" Tire	5738
E	2	Spacer	5968 (Briggs) 50174 (Honda)
F	2	Hitch Pin	5409

Starting Instructions

The Briggs motor is different from the Honda motor and consequently has a different starting procedure. With the fuel tank and crankcase full the motor is ready to be started.

- Briggs
- 1) Set the upper control lever to the "choke" position.
 - 2) Set the lower control lever to the "fast" position.
 - 3) Pull the starter cord.
 - 4) Once the motor begins to run, set the upper control level to the "run" position.

- Honda
- 1) Make sure the fuel switch is in the "on" position.
 - 2) Move the choke switch to the left (located above the fuel switch).
 - 3) Set the selector switch to the "on" position.
 - 4) Move the throttle lever slightly to the left.
 - 5) Pull the starter cord.
 - 6) Once the motor begins to run, move the throttle to the right to increase the motor speed, and move the choke lever to the right.

To turn off either motor, turn the switch to the "off" position. For more detailed instructions refer to the information provided by the specific manufacturer.

Operational Tip

When using a GEOGUARD engine driven compressor as the air source, don't connect the 25 foot long airline to the compressor (from the pump cycle controller) until the motor has been started. The compressor will start easier without a load attached to it.

Parts Listing

The following items may periodically require maintenance or replacement, typically due to the rigors of long term portable usage.

Item	Description	GEOGUARD Model Number
1	Compressor Intake Filter	5894
2	Compressor Shroud	5977
3	Compressor Fan	50157
4	Pressure Relief Valve	5377
5	Drive Belt	5513
6	Motor Pulley	5514
7	Belt Guard	5583
8	Quick Connect Nipple	5022

MASTER-FLD

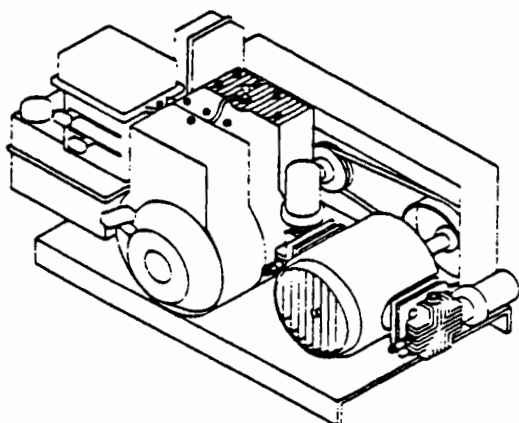
Ground Water Sampling Systems

PORTABLE OIL-LESS AIR COMPRESSORS

Lift, flow rate and reliability of a ground water sampling system require a dependable, practically designed and portable compressed air source. GEOGUARD compressors are capable of producing lifts of up to 250 feet and displace sufficient air to provide the highest pumping rates in the industry. All GEOGUARD compressors are oil-less, providing instrument grade air that contains no hydrocarbon in the air stream.

GEOGUARD compressors have earned the reputation as rugged, low maintenance, high performing, portable compressed air sources for pneumatic pumping systems.

- Choice of either Briggs & Stratton or Honda engines.
- Rugged, dual-piston compressor head with Teflon® piston rings and stainless steel valves for years of dependable service.
- Oil-less compressor unit never requires lubrication and does not deliver oil mist in the air stream.
- Vibration dampened design.
- OSHA approved belt guard.
- 125 psi continuous operation.



DESIGN SPECIFICATIONS

MODEL # : 5404

WEIGHT: 70 LBS.

DIMENSIONS: 25.5" L x
12.3" W x 14.5" H

MAXIMUM PRESSURE: 125
PSI

DUTY: CONTINUOUS

DISPLACEMENT:
4.3

POWER SOURCE:
3.5 H.P. BRIGGS &
STRATTON V/C GASOLINE
ENGINE

MODEL # : 5404-H

WEIGHT: 70 LBS.

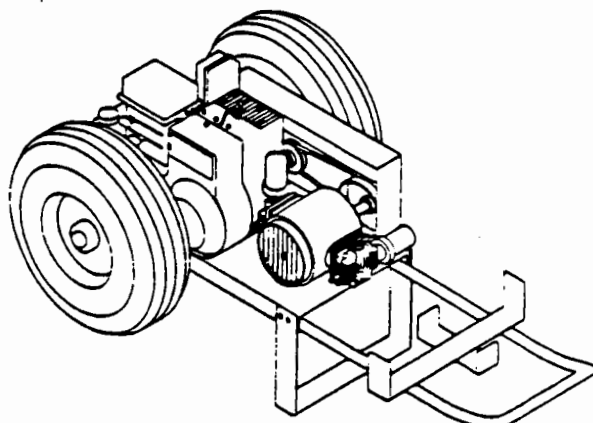
DIMENSIONS: 25.5" L x
12.3" W x 14.5" H

MAXIMUM PRESSURE: 125
PSI

DUTY: CONTINUOUS

DISPLACEMENT:
4.3 SCFM

POWER SOURCE:
4 H.P. HONDA V/C GASOLINE
ENGINE



DESIGN SPECIFICATIONS

MODEL # : 5420

WEIGHT: 87 LBS.

DIMENSIONS: 49" L x 22" W x
21" H

MAXIMUM PRESSURE: 125
PSI

DUTY: CONTINUOUS

DISPLACEMENT:
4.3 SCFM

POWER SOURCE:
3.5 H.P. BRIGGS & STRATTON
V/C GASOLINE ENGINE

TIRES: 16" PNEUMATIC,
HIGH FLOTATION

MODEL # : 5420-H

WEIGHT: 87 LBS.

DIMENSIONS: 49" L x 22" W x
21" H

MAXIMUM PRESSURE: 125
PSI

DUTY: CONTINUOUS

DISPLACEMENT:
4.3 SCFM

POWER SOURCE:
4 H.P. HONDA V/C GASOLINE
ENGINE

TIRES: 16" PNEUMATIC,
HIGH FLOTATION

For applications assistance call 1-800-645-7654.

PORTABLE OIL-LESS AIR COMPRESSORS

ENGINEERING SPECIFICATIONS MODEL 5404/5404-H COMPRESSOR ASSEMBLY

1. The compressor assembly shall be a completely self-contained portable package.
2. The compressor assembly shall incorporate an industrial oil-less 125 psi compressor (i.e. instrument grade air).
3. The compressor assembly shall be capable of operating continuously at 125 psi.
4. The compressor assembly shall be capable of delivering 4.3 SCFM at 125 psi.
5. The compressor assembly shall incorporate an OSHA approved belt guard.
6. Select one of the following:
 - a. The compressor assembly shall incorporate a Briggs & Stratton Industrial/Commercial, 3.5 h.p. gasoline engine (Model 5404).
 - b. The compressor assembly shall incorporate a Honda Industrial/Commercial, 4 h.p. gasoline engine (Model 5404-H).

ENGINEERING SPECIFICATIONS MODEL 5420/5420-H COMPRESSOR ASSEMBLY

1. The compressor assembly shall be a completely self-contained portable package.
2. The compressor assembly shall be mounted on a cart with detachable 16-inch wheels, detachable handle and controller mounting bracket.
3. The compressor assembly shall incorporate an industrial oil-less 125 psi compressor (i.e. instrument grade air).
4. The compressor assembly shall be capable of operating continuously at 125 psi.
5. The compressor assembly shall be capable of delivering 4.3 SCFM at 125 psi.
6. The compressor assembly shall incorporate an OSHA approved belt guard.
7. Select one of the following:
 - a. The compressor assembly shall incorporate a Briggs & Stratton Industrial/Commercial, 3.5 h.p. gasoline engine (Model 5420).
 - b. The compressor assembly shall incorporate a Honda Industrial/Commercial, 4 h.p. gasoline engine (Model 5420-H).

GEUGUARD
Dedicated To Ground Water Technology

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MASTER-FLD

Ground Water Sampling Systems

SAMPLING CADDY

The GEOGUARD Sampling Caddy provides a completely portable ground water sampling system. The unit is easily handled by one person and disassembles for easy transport.

Oil-less Compressor Assembly

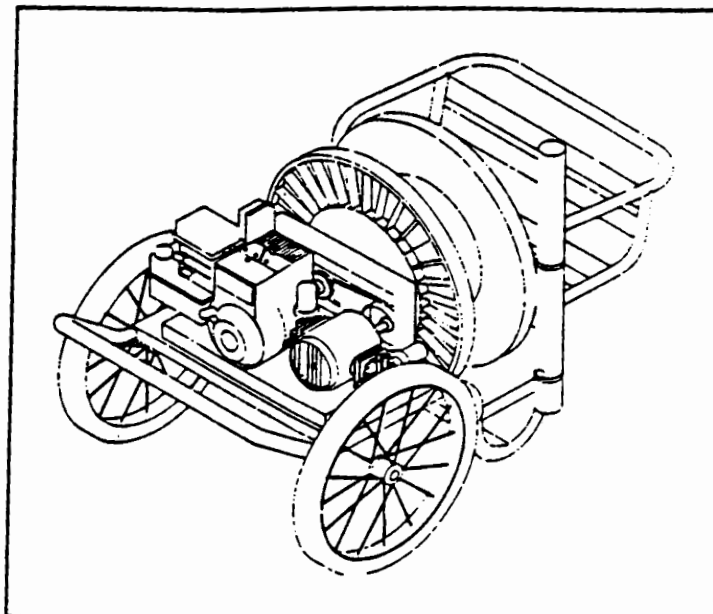
Lift, flow rate reliability of a ground water sampling system require a dependable, practically designed portable compressed air source. GEOGUARD compressors are capable of producing lifts of up to 250 feet and displace sufficient air provide the highest pumping rates in the industry, while providing instrument grade air that contains no hydrocarbon in the air stream.

GEOGUARD compressors have earned the reputation as rugged, low maintenance, high performing portable compressed air sources for pneumatic pumping systems.

- Choice of either Briggs & Stratton or Honda engines.
- Rugged, dual-piston compressor head with Teflon® piston rings and stainless steel valves providing years of dependable service.
- Oil-less compressor unit never requires lubrication and does not deliver oil mist in the air stream.
- Vibration dampened design
- OSHA approved belt guard.
- 125 psi continuous operation.

Cart Frame

The rugged tubular aluminum cart frame includes an equipment rack for carrying the controller, with enough room left for incidentals. It also includes a pump carrying container for storing the pump from well to well.



Tubing Reel

The tubing reel will hold up to 200 feet of coaxial or twin tubing. Its structural foam construction provides durability. Reel can be locked in place utilizing integral "spool lock".

20-inch Spoked Wheels

The wheels easily detach from the cart frame for easy vehicular transport. The 20-inch diameter is useful when traversing through rough terrain.

For applications assistance call 1-800-645-7654 .

SAMPLING CADDY

DESIGN SPECIFICATIONS

MODEL #	5401
WEIGHT :	100 lbs/4.45 kg
LENGTH:	48 in/122 cm
WIDTH:	24 in/61 cm
HEIGHT:	29 in/73.7 cm
MAXIMUM PRESSURE:	125 psi
DUTY:	CONTINUOUS
DISPLACEMENT:	4.3 SCFM
POWER SOURCE:	3.5 h.p. Briggs & Stratton I/C gasoline engine
TIRES:	20" Semi-Pneumatic

DESIGN SPECIFICATIONS

MODEL #	5401-H
WEIGHT :	100 lbs/4.45 kg
LENGTH:	48 in/122 cm
WIDTH:	24 in/61 cm
HEIGHT:	29 in/73.7 cm
MAXIMUM PRESSURE:	125 psi
DUTY:	CONTINUOUS
DISPLACEMENT:	4.3 SCFM
POWER SOURCE:	4 h.p. Honda I/C gasoline engine
TIRES:	20" Semi-Pneumatic

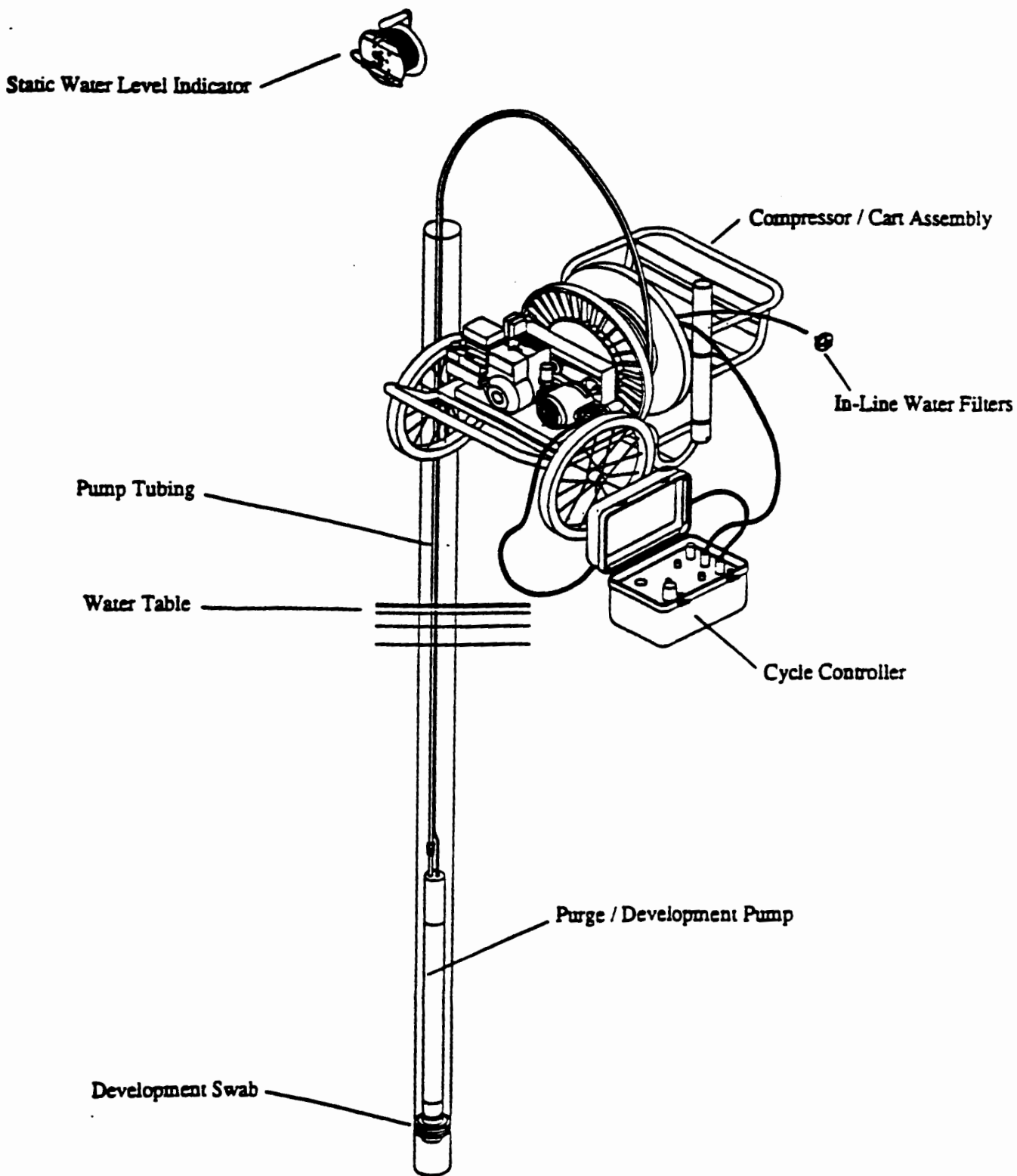
ENGINEERING SPECIFICATIONS

- 1) The compressor assembly shall be a completely self-contained portable package.
- 2) The compressor assembly shall be mounted on a tubular aluminum frame cart with detachable 20-inch wheels, tubing spool and equipment rack.
- 3) The compressor assembly shall incorporate an industrial oil-less 125 psi compressor (ie. instrument grade air.)
- 4) The compressor assembly shall be capable of operating continuously at 125 psi.
- 5) The compressor assembly shall be capable of delivering 4.3 SCFM at 125 psi.
- 6) The compressor assembly shall incorporate an OSHA approved belt guard.
- 7) Select one of the following:
 - a) The compressor assembly shall incorporate a Briggs & Stratton Industrial/Commercial, 3.5 h.p. gasoline engine (Model 5401).
 - b) The compressor assembly shall incorporate a Honda Industrial/Commercial, 4 h.p. gasoline engine (Model 5401-H).

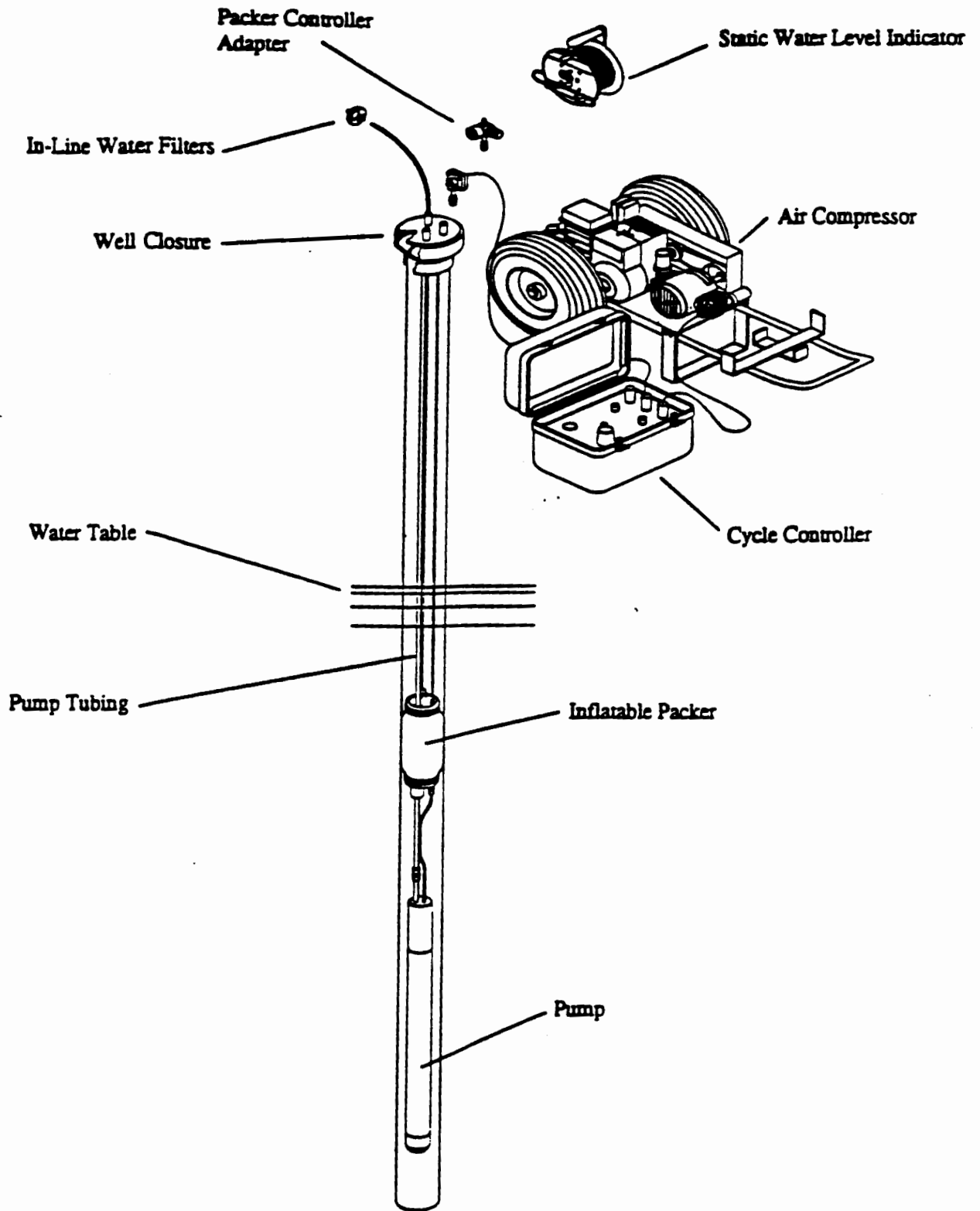
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Basic Portable System



Basic Dedicated System

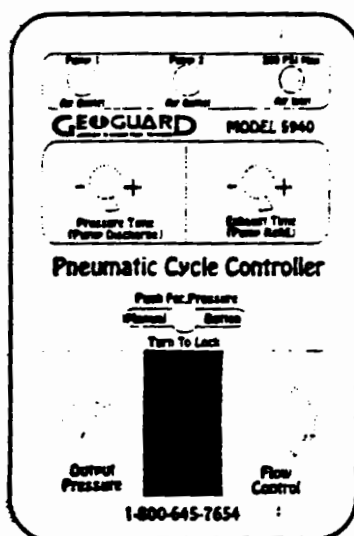
MASTER-FLD

Ground Water Sampling Systems

FULLY PNEUMATIC AUTOMATIC PUMP CYCLE CONTROLLER

GEOGUARD Pump Cycle Controllers manage the compressed air used to power pneumatic pumps. They are designed with large air paths so as not to restrict the air flow as it moves from the compressed air source to the pump.

- Fine tuning, single rotation timer adjustment provides optimum pump flow rate.
- Sensitive air flow control permits high purging rates and low (less than 100ml/min.) sample rates.
- 200 psi pressure capability allows lifts up to 450 feet (135 m).
- Quick exhaust valve "short circuits" exhausting air, permits the pump to fill faster for higher purging flow rates.
- Non-corroding, quick-connect hose attachments.
- Over pressure protection.
- Liquid dampened pressure gauge.
- Manual override bypasses the timers for manual operation (used for "cold weather blow outs", packer inflation, etc.).
- Moisture trap/air filter prevents water and particulate matter from entering controller, tubing and pump.
- Enclosed in a rugged, environmentally sealed, shock resistant case.
- Doubling acting feature permits operation of two pumps. (Note: Requires additional air hose from controller to pump. Part number 50090.)



Design Specifications

Model#: 5940

Weight: 10 lbs.

Dimensions: 14.5" L x 10" D x 9" W

Timer Range: Fill = 1 to 180 seconds. Discharge = 1 to 60 seconds. Independently adjustable.

Pressure Capability: 200 psi.

Power Source: Compressed air.

Air Hose: .375" I.D. reinforced, industrial air hose. Compressed air source to controller hose length is 25 ft. and includes quick-connect fittings. Controller to pump hose length is 10 ft. and includes quick-exhaust valve and quick-connect fittings. (Optional lengths available upon request).

For applications assistance call 1-800-645-7654.

ATTACHMENT 2

USEPA Low Stress Purging/Sampling Protocol

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I

LOW STRESS (low flow) PURGING AND SAMPLING PROCEDURE
FOR THE COLLECTION OF GROUND WATER SAMPLES
FROM MONITORING WELLS

I. SCOPE & APPLICATION

This standard operating procedure (SOP) provides a general framework for collecting ground water samples that are indicative of mobile organic and inorganic loads at ambient flow conditions (both the dissolved fraction and the fraction associated with mobile particulates). The SOP emphasizes the need to minimize stress by low water-level drawdowns, and low pumping rates (usually less than 1 liter/min) in order to collect samples with minimal alterations to water chemistry. This SOP is aimed primarily at sampling monitoring wells that can accept a submersible pump and have a screen, or open interval length of 10 feet or less (this is the most common situation). However, this procedure is flexible and can be used in a variety of well construction and ground-water yield situations. Samples thus obtained are suitable for analyses of ground water contaminants (volatile and semi-volatile organic analytes, pesticides, PCBs, metals and other inorganics), or other naturally occurring analytes.

This procedure does not address the collection of samples from wells containing light or dense non-aqueous phase liquids (LNAPLs and DNAPLs). For this the reader may wish to check: Cohen, R.M. and J.W. Mercer, 1993, DNAPL Site Evaluation; C.K. Smoley (CRC Press), Boca Raton, Florida and U.S. Environmental Protection Agency, 1992, RCRA Ground-Water Monitoring: Draft Technical Guidance; Washington, DC (EPA/530-R-93-001).

The screen, or open interval of the monitoring well should be optimally located (both laterally and vertically) to intercept existing contaminant plume(s) or along flowpaths of potential contaminant releases. It is presumed that the analytes of interest move (or potentially move) primarily through the more permeable zones within the screen, or open interval.

Use of trademark names does not imply endorsement by U.S.EPA but is intended only to assist in identification of a specific type of device.

Proper well construction and development cannot be overemphasized, since the use of installation techniques that are appropriate to the hydrogeologic setting often prevents "problem well" situations from occurring. It is also recommended that as part of development or redevelopment the well should be tested to determine the appropriate pumping rate to obtain stabilization of field indicator parameters with minimal drawdown in shortest amount of time. With this information field crews can then conduct purging and sampling in a more expeditious manner.

The mid-point of the saturated screen length (which should not exceed 10 feet) is used by convention as the location of the pump intake. However, significant chemical or permeability contrast(s) within the screen may require additional field work to determine the optimum vertical location(s) for the intake, and appropriate pumping rate(s) for purging and sampling more localized target zone(s). Primary flow zones (high(er) permeability and/or high(er) chemical concentrations) should be identified in wells with screen lengths longer than 10 feet, or in wells with open boreholes in bedrock. Targeting these zones for water sampling will help insure that the low stress procedure will not underestimate contaminant concentrations. The Sampling and Analysis Plan must provide clear instructions on how the pump intake depth(s) will be selected, and reason(s) for the depth(s) selected.

Stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels of less than 5 NTU and stable drawdowns of less than 0.3 feet, while desirable, are not mandatory. Sample collection may still take place provided the remaining criteria in this procedure are met. If after 4 hours of purging indicator field parameters have not stabilized, one of 3 optional courses of action may be taken: a) continue purging until stabilization is achieved, b) discontinue purging, do not collect any samples, and record in log book that stabilization could not be achieved (documentation must describe attempts to achieve stabilization) c) discontinue purging, collect samples and provide full explanation of attempts to achieve stabilization (note: there is a risk that the analytical data obtained, especially metals and strongly hydrophobic organic analytes, may not meet the sampling objectives).

Changes to this SOP should be proposed and discussed when the site Sampling and Analysis Plan is submitted for approval. Subsequent requests for modifications of an approved plan must include adequate technical justification for proposed changes. All changes and modifications must be approved before implementation in field.

II. EQUIPMENT

A. Extraction device

Adjustable rate, submersible pumps are preferred (for example, centrifugal or bladder pump constructed of stainless steel or Teflon).

Adjustable rate, peristaltic pumps (suction) may be used with caution. Note that EPA guidance states: "Suction pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds" (EPA/540/P-87/001, 1987, page 8.5-11).

The use of inertial pumps is discouraged. These devices frequently cause greater disturbance during purging and sampling and are less easily controlled than the pumps listed above. This can lead to sampling results that are adversely affected by purging and sampling operations, and a higher degree of data variability.

B. Tubing

Teflon or Teflon lined polyethylene tubing are preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs and inorganics.

PVC, polypropylene or polyethylene tubing may be used when collecting samples for inorganics analyses. However, these materials should be used with caution when sampling for organics. If these materials are used, the equipment blank (which includes the tubing) data must show that these materials do not add contaminants to the sample.

Stainless steel tubing may be used when sampling for VOCs, SVOCs, pesticides, and PCBs. However, it should be used with caution when sampling for metals.

The use of 1/4 inch or 3/8 inch (inner diameter) tubing is preferred. This will help ensure the tubing remains liquid filled when operating at very low pumping rates.

Pharmaceutical grade (Pharmed) tubing should be used for the section around the rotor head of a peristaltic pump, to minimize gaseous diffusion.

C. Water level measuring device(s), capable of measuring to 0.01 foot accuracy (electronic "tape", pressure transducer). Recording pressure transducers, mounted above the pump, are especially helpful in tracking water levels during pumping operations, but their use

must include check measurements with a water level "tape" at the start and end of each record.

D. Flow measurement supplies (e.g., graduated cylinder and stop watch).

E. Interface probe, if needed.

F. Power source (generator, nitrogen tank, etc.). If a gasoline generator is used, it must be located downwind and at least 30 feet from the well so that the exhaust fumes do not contaminate the samples.

G. Indicator field parameter monitoring instruments - pH, Eh, dissolved oxygen (DO), turbidity, specific conductance, and temperature. Use of a flow-through-cell is required when measuring all listed parameters, except turbidity. Standards to perform field calibration of instruments. Analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW-846. For Eh measurements, follow manufacturer's instructions.

H. Decontamination supplies (for example, non-phosphate detergent, distilled/deionized water, isopropyl alcohol, etc.).

I. Logbook(s), and other forms (for example, well purging forms).

J. Sample Bottles.

K. Sample preservation supplies (as required by the analytical methods).

L. Sample tags or labels.

M. Well construction data, location map, field data from last sampling event.

N. Well keys.

O. Site specific Sample and Analysis Plan/Quality Assurance Project Plan.

P. PID or FID instrument (if appropriate) to detect VOCs for health and safety purposes, and provide qualitative field evaluations.

III. PRELIMINARY SITE ACTIVITIES

Check well for security damage or evidence of tampering, record pertinent observations.

Lay out sheet of clean polyethylene for monitoring and sampling equipment.

Remove well cap and immediately measure VOCs at the rim of the well with a PID or FID instrument and record the reading in the field logbook.

If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Describe its location and record the date of the mark in the logbook.

A synoptic water level measurement round should be performed (in the shortest possible time) before any purging and sampling activities begin. It is recommended that water level depth (to 0.01 ft.) and total well depth (to 0.1 ft.) be measured the day before, in order to allow for re-settlement of any particulates in the water column. If measurement of total well depth is not made the day before, it should not be measured until after sampling of the well is complete. All measurements must be taken from the established referenced point. Care should be taken to minimize water column disturbance.

Check newly constructed wells for the presence of LNAPLs or DNAPLs before the initial sampling round. If none are encountered, subsequent check measurements with an interface probe are usually not needed unless analytical data or field head space information signal a worsening situation. Note: procedures for collection of LNAPL and DNAPL samples are not addressed in this SOP.

IV. PURGING AND SAMPLING PROCEDURE

Sampling wells in order of increasing chemical concentrations (known or anticipated) is preferred.

1. Install Pump

Lower pump, safety cable, tubing and electrical lines slowly (to minimize disturbance) into the well to the midpoint of the zone to be sampled. The Sampling and Analysis Plan should specify the sampling depth, or provide criteria for selection of intake depth for each well (see Section I). If possible keep the pump intake at least two

feet above the bottom of the well, to minimize mobilization of particulates present in the bottom of the well. Collection of turbid free water samples may be especially difficult if there is two feet or less of standing water in the well.

2. Measure Water Level

Before starting pump, measure water level. If recording pressure transducer is used-initialize starting condition.

3. Purge Well

3a. Initial Low Stress Sampling Event

Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check water level. Adjust pump speed until there is little or no water level drawdown (less than 0.3 feet). If the minimal drawdown that can be achieved exceeds 0.3 feet but remains stable, continue purging until indicator field parameters stabilize.

Monitor and record water level and pumping rate every three to five minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump (for example, 0.1 - 0.4 l/min) to ensure stabilization of indicator parameters. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. Do not allow the water level to fall to the intake level (if the static water level is above the well screen, avoid lowering the water level into the screen). The final purge volume must be greater than the stabilized drawdown volume plus the extraction tubing volume.

Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (bladder, peristaltic), and/or the use of dedicated equipment. If the recharge rate of the well is lower than extraction rate capabilities of currently manufactured pumps and the well is essentially dewatered during purging, then the well should be sampled as soon as the water level has recovered sufficiently to collect the appropriate volume needed for all anticipated samples (ideally the intake should not be moved during this recovery period). Samples may then be collected even though the indicator field parameters have not stabilized.

3b. Subsequent Low Stress Sampling Events

After synoptic water level measurement round, check intake depth and drawdown information from previous sampling event(s) for each well. Duplicate, to the extent practicable, the intake depth and extraction rate (use final pump dial setting information) from previous event(s). Perform purging operations as above.

4. Monitor Indicator Field Parameters

During well purging, monitor indicator field parameters (turbidity, temperature, specific conductance, pH, Eh, DO) every three to five minutes (or less frequently, if appropriate). Note: during the early phase of purging emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at three (3) to five (5) minute intervals, are within the following limits:

- turbidity (10% for values greater than 1 NTU),
- DO (10%),
- specific conductance (3%),
- temperature (3%),
- pH (± 0.1 unit),
- ORP/Eh (± 10 millivolts).

All measurements, except turbidity, must be obtained using a flow-through-cell. Transparent flow-through-cells are preferred, because they allow field personnel to watch for particulate build-up within the cell. This build-up may affect indicator field parameter values measured within the cell and may also cause an underestimation of turbidity values measured after the cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect cell for cleaning, then reconnect after cleaning and continue monitoring activities.

The flow-through-cell must be designed in a way that prevents air bubble entrapment in the cell. When the pump is turned off or cycling on/off (when using a bladder pump), water in the cell must not drain out. Monitoring probes must be submerged in water at all times. If two flow-through-cells are used in series, the one containing the dissolved oxygen probe should come first (this parameter is most susceptible to error if air leaks into the system).

5. Collect Water Samples

Water samples for laboratory analyses must be collected before water has passed through the flow-through-cell (use a by-pass assembly or disconnect cell to obtain sample).

VOC samples should be collected first and directly into pre-preserved sample containers. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

During purging and sampling, the tubing should remain filled with water so as to minimize possible changes in water chemistry upon contact with the atmosphere. It is recommended that 1/4 inch or 3/8 inch (inside diameter) tubing be used to help insure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use one of the following procedures to collect samples: (1) add clamp, connector (Teflon or stainless steel) or valve to constrict sampling end of tubing; (2) insert small diameter Teflon tubing into water filled portion of pump tubing allowing the end to protrude beyond the end of the pump tubing, collect sample from small diameter tubing; (3) collect non-VOC samples first, then increase flow rate slightly until the water completely fills the tubing, collect sample and record new drawdown, flow rate and new indicator field parameter values.

Add preservative, as required by analytical methods, to samples immediately after they are collected if the sample containers are not pre-preserved. Check analytical methods (e.g. EPA SW-846, water supply, etc.) for additional information on preservation. Check pH for all samples requiring pH adjustment to assure proper pH value. For VOC samples, this will require that a test sample be collected during purging to determine the amount of preservative that needs to be added to the sample containers prior to sampling.

If determination of filtered metal concentrations is a sampling objective, collect filtered water samples using the same low flow procedures. The use of an in-line filter is required, and the filter size (0.45 um is commonly used) should be based on the sampling objective. Pre-rinse the filter with approximately 25 - 50 ml of ground water prior to sample collection. Preserve filtered water sample immediately. Note: filtered water samples are not an acceptable substitute for unfiltered samples when the monitoring objective is to obtain chemical concentrations of total mobile contaminants in ground water for human health risk calculations.

Label each sample as collected. Samples requiring cooling (volatile organics, cyanide, etc.) will be placed into a cooler with ice or refrigerant for delivery to the laboratory. Metal samples after acidification to a pH less than 2 do not need to be cooled.

6. Post Sampling Activities

If recording pressure transducer is used, remeasure water level with tape.

After collection of the samples, the pump tubing may either be dedicated to the well for resampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

Before securing the well, measure and record the well depth (to 0.1 ft.), if not measured the day before purging began. Note: measurement of total well depth is optional after the initial low stress sampling event. However, it is recommended if the well has a "silt" problem or if confirmation of well identity is needed.

Secure the well.

V. DECONTAMINATION

Decontaminate sampling equipment prior to use in the first well and following sampling of each subsequent well. Pumps will not be removed between purging and sampling operations. The pump and tubing (including support cable and electrical wires which are in contact with the well) will be decontaminated by one of the procedures listed below.

Procedure 1

The decontaminating solutions can be pumped from either buckets or short PVC casing sections through the pump or the pump can be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and isopropyl alcohol be used sparingly in the decontamination process and water flushing steps be extended to ensure that any sediment trapped in the pump is removed. The pump exterior and electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

Flush the equipment/pump with potable water.

Flush with non-phosphate detergent solution. If the solution is

recycled, the solution must be changed periodically.

Flush with potable or distilled/deionized water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.

Flush with isopropyl alcohol (pesticide grade). If equipment blank data from the previous sampling event show that the level of contaminants is insignificant, then this step may be skipped.

Flush with distilled/deionized water. The final water rinse must not be recycled.

Procedure 2

Steam clean the outside of the submersible pump.

Pump hot potable water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.

Pump potable water through the inside of the pump to remove all of the detergent solution. If the solution is recycled, the solution must be changed periodically.

Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

VI. FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not compromised the quality of the ground water samples. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples shall be collected for each batch of samples (a batch

may not exceed 20 samples). Trip blanks are required for the VOC samples at a frequency of one set per VOC sample cooler.

Field duplicate.

Matrix spike.

Matrix spike duplicate.

Equipment blank.

Trip blank (VOCs).

Temperature blank (one per sample cooler).

Equipment blank shall include the pump and the pump's tubing. If tubing is dedicated to the well, the equipment blank will only include the pump in subsequent sampling rounds.

Collect samples in order from wells with lowest contaminant concentration to highest concentration. Collect equipment blanks after sampling from contaminated wells and not after background wells.

Field duplicates are collected to determine precision of sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

If split samples are to be collected, collect split for each analyte group in consecutive order (VOC original, VOC split, etc.). Split sample should be as identical as possible to original sample.

All monitoring instrumentation shall be operated in accordance with EPA analytical methods and manufacturer's operating instructions. EPA analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW-846 with exception of Eh, for which the manufacturer's instructions are to be followed. Instruments shall be calibrated at the beginning of each day. If a measurement falls outside the calibration range, the instrument should be re-calibrated so that all measurements fall within the calibration range. At the end of each day, check calibration to verify that instruments remained in calibration. Temperature measuring equipment, thermometers and thermistors, need not be calibrated to the above frequency. They should be checked for accuracy prior to field use according to EPA Methods and the manufacturer's instructions.

VII. FIELD LOGBOOK

A field log shall be kept to document all ground water field monitoring activities (see attached example matrix), and record all of the following:

Well identification.

Well depth, and measurement technique.

Static water level depth, date, time and measurement technique.

Presence and thickness of immiscible liquid (NAPL) layers and detection method.

Pumping rate, drawdown, indicator parameters values, and clock time, at the appropriate time intervals; calculated or measured total volume pumped.

Well sampling sequence and time of each sample collection.

Types of sample bottles used and sample identification numbers.

Preservatives used.

Parameters requested for analysis.

Field observations during sampling event.

Name of sample collector(s).

Weather conditions.

QA/QC data for field instruments.

Any problems encountered should be highlighted.

Description of all sampling equipment used, including trade names, model number, diameters, material composition, etc.

VIII. DATA REPORT

Data reports are to include laboratory analytical results, QA/QC information, and whatever field logbook information is needed to allow for a full evaluation of data useability.

Page ____ of ____

[illegible]

1. Pump dial setting (for example: hertz, cycles/min, etc).
2. μ Siemens per cm (same as μ mhos/cm) at 25°C.
3. Oxidation reduction potential (stand in for Eh).